Chapter 1: Drawing Green Fields: Architects' Representations of Airport Space

Architects are way too agreeable to just draw, draw, draw.
Our passion is drawing.
Architect A8

Well, it is not actually.
It is not green,
it is not a field.
Architect A11

This chapter begins this thesis' investigation into the production of airport space by examining the work of architects involved in the design and construction of airports. It is written on the basis of interviews with eleven such architects, primarily conducted in spring 2015 in New York City.[1] Most of these architects work in globally operating architectural firms which are large enough to work on projects as complex as airport buildings. Many of these firms have offices in New York City, and this is why this location was chosen for interviews.[2] To give an idea of the circumstances of the interviews, I would like to recount one aspect of my first interview, with Architect A1. The interview was interrupted by a telephone call about an airport in the Middle East, on which the interviewee was working at the time. While the interviewee had asked me not to record the conversation on the phone itself, they explained the circumstances of the call when we continued the interview. Taking my notepad, Architect A1 explains:

> I do not know if you are familiar with [the airport in question] at all, but I will draw it for you. Let me have your book and I show you:
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> The current airport is configured this way. [They speak as they draw.] One, two, three, four, and terminals 1 and 2 are actively being used right now, terminal 3 has some use and terminal 4 is derelict; it is not being used. These terminals were all built in the early 1980s. Currently, we have a contract to do this. [They draw.] That is our scope of our work. This is 3.3 million square feet.
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> There is a board meeting going on at this moment in Germany with the general contractor who is going to build all this work out. And he is asking the question in his board meeting: He would like us to get under contract, or at least a working understanding, as to what it would take to do this [they draw as they speak] in reverse and to do the mirror of this [they draw], and for how much of a discount would we be willing to do the reverse? And so, if you heard in our conversation, I said that our numbers would be about 60 per cent of this [they point], to do this. Because in many cases we use a tool called Revit. [They write down the name in my notepad.] You

[1] Cf. Appendix 2. With the exception on A11, who was interviewed in London, in spring 2016.
[2] For a useful overview, cf. Vanessa Quirk, "The 100 Largest Architecture Firms In the World," published on 11/02/13, on *ArchDaily*, http://www.archdaily.com/330759/the-100-largest-architecture-firms-in-the-world (accessed 23/12/15).

> should know that term. It is an architectural modelling software that enables you to do a three dimensional model. So what we will be able to do in some cases actually is to take the mirror image of some of the model and invert it and not have to redesign it. And this is kind of interesting – this is too much information for you, but bear with me – whatever we do today may not be relevant tomorrow because if the building code changes, or if the size of the aircraft changes, or any of these events could occur, then our ability to immediately reuse these things would be called into question.
>
> So, that is what we are trying to do in a hurried phone call in real time, trying to take a wild guess to negotiate a fee. That is a watershed moment right there. It is a little different. Now you know. That is real time, exactly what we are dealing with. And that piece there is worth just under a billion.

The episode exemplifies the circumstances in which architects were interviewed. The New York City-based architect's phone call from a board meeting in Germany about the future development of a Middle Eastern airport illustrates the collaborative nature of architectural work on a global scale.

While Architect A1 illustrates the use of communication technology in bridging the distance between New York City, Germany and the Middle East, Architect A6 argues they themselves need to travel. Having explained that they also work on many projects in the Middle East, Architect A6 recounts: 'I remember having met people, they were clients, they were partners, and we would talk and talk and talk and talk – emails, telephone calls, go to meetings, Skype, whatever it was'. The interviewee continues to explain that their efforts remained unsuccessful and they were unable to secure work. Then, however, they continue: 'One day, I got on an airplane, visited them. And in that part of the world, when you make the effort to come visit me, it is a very different thing than when you talk to me on the phone. The next day, I got a project'. In this account, the need to travel globally, seemingly in order to accommodate local preferences 'in that part of the world', becomes apparent. Indeed, the status of the architects interviewed here as part of the globally moving 'kinetic elite' resonates in side remarks throughout the interviews.[3] Interviewees make reference to projects at locations throughout the world. Some mention their personal travel; Architect A6 states for example: 'I just came back from Vietnam three days ago. Three flights, 36.5 hours'. In a similar vein, Architect A8 explains that they fly often enough to be recognised by flight attendants – 'You know, it is fun to be recognised on a flight by a flight attendant: "Oh my god, hey, where are you going this time?" I have seen flight attendants I know. "Where are you headed?", "I am headed to

[3] John Urry, *Mobilities* (Cambridge: Polity, 2007), 152. Cf. Tim Cresswell, *On the Move: Mobility in the Modern Western World* (New York: Routledge, 2006), 255. For a critical discussions, cf. Jana Costas, "Problematizing Mobility: A Metaphor of Stickiness, Non-Places and the Kinetic Elite," *Organization Studies* 34, no. 10 (2013): 1467–1485.

Barcelona. Where are you heading?" and it feels great'. This is significant because some interviewees speculated that their travel as passengers impacts their work as architects, and vice versa. Architect A10 explains, for example:

> Obviously, everywhere I go, I am noting things that I think are positive or negative about terminal buildings, the airport experience, the connectivity, the landside, all of that kind of thing, for sure. One is always trying to absorb. You cannot help that you look at signage, you look at the retail offerings. You cannot help but judge.

My interviews, in other words, constitute encounters with a mobile elite who operate on a global scale, and whose movement may – in turn – impact their thinking about airports.

De Monchaux points out that the complex organisation of architectural firms is often obscured by the 'branding' of their work which attributes it to their founding architect.[4] Such a branding is well illustrated in the attention paid to so-called "starchitects", such as Eero Saarinen, Norman Foster, Richard Rogers, Frank Gehry, and Rem Koolhaas in the case of airport architecture.[5] Saarinen's TWA terminal, for example, has already been mentioned in the introduction and we will return to it in the fourth chapter. The focus on particular architects, de Monchaux suggests, can obscure the collaborative nature of architectural work. He writes that 'the design and construction of buildings has always been a vast conspiracy disguised as a singular event'.[6] Indeed, explaining the organisation of their firm, Architect A8 begins by stating that 'people have certain passions'. They continue to explain that 'some people are more technically based architects, some people are more design based architects, some people are just natural managers of people – people people – and so you find your passion and then you work together as teams'. Most interviewees will likely fall into the category of 'people people', able to convey the complex working relations within their firms to an outsider such as myself.[7] More often than not, interviewees re-scheduled one or several times to accommodate unexpected meetings. Interruptions by phone calls or emails or colleagues entering the room were not infrequent. While these conversations were never recorded, interviewees often elaborated on them afterwards. As such, these interruptions became unplanned connections between the interviews and architects' everyday working practices. Building on these

[4] Thomas de Monchaux, "Clear All Ghosted, " in *SOM Journal 9* (Ostfildern: Hatje Cantz/Skidmore, Owings and Merrill, 2014), 109.
[5] Other examples, discussed by Lefebvre, are Le Corbusier and Lloyd Wright (Henri Lefebvre, *The Production of Space*, trans. Donald Nicholson-Smith (Oxford: Blackwell, 1991), 43.)
[6] de Monchaux, "Clear All Ghosted," 109.
[7] In this regard, my perspective is similar to that of Elizabeth Grosz, *Architecture from the Outside: Essays on Virtual and Real Space*, foreword by Peter Eisenman (Cambridge, Mass.: The MIT Press, 2001).

experiences, my intention in this chapter is to point towards the collaborative work of producing airport buildings.

I now move on to the two main sections of the chapter. Part I discusses architects' representations of space. It begins by discussing drawing by hand and then moves on to discuss BIM, Building Information Modelling/Management.[8] It is concerned with the impact of BIM on architects' representations of space and on the relation between architects and the construction industry. Part II is concerned with the modelling of passenger flows throughout the building, and the assumptions made about its growth.

Part I: 'Our passion is drawing'

After I pass them my notebook, Architect A1 draws a birds-eye view of the layout of the airport building in question to substitute for my lack of familiarity.[9] The act of drawing becomes a means of articulating their thinking, and they modify the drawing to illustrate their explanations throughout the conversation.[10] Architect A1 is not alone in their use of drawing; other interviewees also use drawings and less frequently photos and maps, as illustrations and as means of communication.[11] I did not contribute to the creation of these drawings, and so, while they were made occur in the context of the dialogue of the interviews whose rhythms have already been discussed in the introduction, the drawings may in fact function *mono*logically. They may have been a means of asserting the architects' unique ability to imagine a building vis-à-vis myself who does not have that ability, with drawings being 'at once idea and social

[8] There is no consensus as to whether 'M' stands for Modelling or Management. (Steve Race, *BIM Demystified: An Architect's guide to Building Information Modelling/Management,* 2nd ed. (London: RIBA Publishing, 2013), 16.) In line with most of my interviewees' choices of word, I refer to Building Information Modelling.

[9] For a related sharing of tools between researcher and researched – albeit in the case of more complex computation tools described below, cf. Albena Yaneva, "Mapping Networks: Leaning from the Epistemology of the "Natives"," in *Visualization in the Age of Computerization*, ed. Annamaria Carusi, Aud Sissel Hoel, Timothy Webmoor and Steve Woolgar (New York: Routledge, 2015) and Matt Edgeworth, "From Spade-Work to Screen-Work: New Forms of Archaeological Discovery in Digital Space," in *Visualization in the Age of Computerization*, ed. Annamaria Carusi, Aud Sissel Hoel, Timothy Webmoor and Steve Woolgar (New York: Routledge, 2015). In Yaneva's case, however, the intention seems to have been a mutual knowledge exchange, whereas in my case the exchange, and the power balance implied, were one-sided. Similarly, Edgeworth asks interesting questions about the use of ethnography to observe the interaction of subjects and their computers.

[10] Cf. Hall and Stevens, in their examination of the mediation of architects' interactions by CAD (computer assisted design) tools, recount not only their participants' verbal communication but also their changes to the sign in the CAD software, and their physical movement. (Rogers Hall and Reed Stevens, "Making space: a comparison of mathematical work in school and professional design practices," in *The Cultures of Computing*, ed. Susan Leigh Star (Oxford: Blackwell/The Sociological Review, 1995).

[11] Cf. Edward Robbins, *Why Architects Draw* (Cambridge, Mass.: The MIT Press, 1994), 34.

action'. [12] In this first part of the chapter, I engage with four aspects of drawing: drawing by hand, computer aided design in the software of the BIM, architects' interaction with the BIM model, and lastly, the relation of architects and the contractors who will construct a building on the basis of their representations.

I.1. Drawing

Architects interviewed for this chapter tend to be concerned not so much with the drawings themselves as with the act of drawing. That is, the architects engage with drawings not only as representations of space but also, and perhaps more importantly, with drawing as a practice in its own right. Drawings as representations of space are produced, they mediate the relation of architect and space, and the relations of architects and other actors also involved in the production of airport space at this stage.

Pointing towards the history of drawing, Architect A6 explains:

> Things used to be drawn by hand, a hundred times, and erased and redrawn. And there was a lot of interpretation, but there was also a lot of skill in the construction industry that can take basic construction and create buildings from them. 500 years ago, 600 years ago, Michelangelo or Brunelleschi would draw the dome in Florence and he would draw a profile of a certain type of stone and he went to a stone mason, who was an artisan who knew how to carve something beautiful, and they were part of a creative process.

This quote is remarkable because it describes processes far removed from present-day architectural work, by making reference to Michelangelo (1475-1564) and Brunelleschi (1377 – 1446) as two Renaissance artists. No other interviewee drew on historical developments as far in the past. The architect points towards the iterative process of drawing, erasing and redrawing, and the subsequent interpretation of the drawing itself by a skilful and knowledgeable stone mason. The two practices – drawing/erasing/redrawing by the architect and the carving of the stone mason – come together in the 'creative process'. Through this process, a building – here the dome of the Florence Cathedral, by Brunelleschi – is created.[13]

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[12] Robbins, *Why Architects Draw*, 34. Robbins also elaborates in detail on the 'social uses of drawing',[12] which may play out in a variety of ways (Robbins, *Why Architects Draw*, 38).

[13] Interestingly, the interviewee's historical account differs from other accounts of drawing in the Renaissance. Cairn and Jacobs write, for example, that the Renaissance saw 'the integration of intellectual and manual labor [begin] to be teased apart.' As a consequence, 'the conception of architectural ideas came to be distinguished from the practices of construction'. This new form of drawing is identified as 'disegno', which relies on a 'tentative, repetitive, and explorative line' vis-à-vis the linear lines previously employed. This echoes the interviewee's description of drawing, erasing and redrawing. (Stephen Cairns and Jane M. Jacobs, *Buildings Must Die: A Perverse view of Architecture* (Cambridge, Mass.: The MIT Press, 2014), 18.) For a similar discussion, in the

The interviewee's emphasis that 'things used to be drawn *by hand'* is important to note. Lefebvre distinguishes between the hand, representative of touch, and the eye, representative of visuality. He emphasises the hand's ability to interact with the material world and writes that 'the sense of touch is the discoverer of matter'.[14] Moreover, the hand can modify such matter through the use of tools, albeit with the consequence of thus separating matter from nature.[15] In drawing, however, the hand is involved in a visual, representational practice, which complicated Lefebvre's scheme. Echoing the interviewee's description of drawing, erasing and redrawing, Belardi has pointed out that the pencil in particular is 'an indulgent tool that not only permits inaccuracies – if not outright errors – but also allows eraser marks (never definitive) to fade away'.[16] Consequently, the 'things' described in the beginning of the quote from Architect A6 are somewhat ephemeral. They are described in no detail when they are first drawn, they then reappear as 'a profile of a certain type of stone' drawn by the architect and then become 'something beautiful' carved by the stone mason.

Lefebvre states that representations of space, such as architects' drawings, have 'a substantial role and a specific influence in the production of space'.[17] This influence is expressed through architecture, which Lefebvre describes as not so much any particular building but as 'a project embedded in a spatial context and a texture'.[18] Representations of space are seen as interventions into a spatial texture of 'knowledge and ideology',[19] and we will see below how this association of knowledge and space plays out in architects' work. Representations of space, in other words, are important in the production of space through their contribution to architecture, understood as a project in a broader social context. Writing about modern times, Lefebvre explains:

> Within the spatial practice of modern society, the architect ensconces himself in his own space. He has a *representation of this space*, one which is bound to graphic elements – to sheets of paper, plans, elevations, sections, perspective views of façades, modules, and so on. This *conceived* space is thought by those who make use of it to be *true*, despite the fact – and perhaps because of the fact – that it is geometrical: because it is a medium for objects, an object itself, and a locus of the objectification of plans.

context of archaeology, cf. Matt Edgeworth, "From Spade-Work to Screen-Work: New Forms of Archaeological Discovery in Digital Space," in *Visualization in the Age of Computerization*, ed. Annamaria Carusi, Aud Sissel Hoel, Timothy Webmoor and Steve Woolgar (New York: Routledge, 2015).

[14] Henri Lefebvre, *The Production of Space*, trans. Donald Nicholson-Smith (Oxford: Blackwell, 1991), 213.

[15] Lefebvre, *The Production of Space*, 213.

[16] Paolo Belardi, *Why Architects Still Draw: Two Lectures on Architectural Drawing*, trans. Zachary Nowak (Cambridge, Mass.: The MIT Press, 2014), 7.

[17] Lefebvre, *The Production of Space*, 42.

[18] Lefebvre, *The Production of Space*, 42.

[19] Lefebvre, *The Production of Space*, 42.

> Its distant ancestor is the linear perspective, developed as early as the Renaissance: a fixed observer, an immobile perceptual field, a stable visual world.[20]

Architects' representation of space is taken to be 'a fact' because they are 'geometrical' and 'objective'. And yet, the drawings discussed here – 'plans, elevations, perspective view of façades, modules', presented on 'sheets of paper' – imply a particular perspective of the architect towards the space they conceive: An architectural plan is a view of a building's floor from above with the aim of representing patterns and relationships on that floor or ground plane,[21] a section is a vertical cut through a building in order to allow a view of the internal workings of a building and an elevation is a view of the façade of a building.[22] Robbins suggests that taken together, these drawings suggests 'a whole series of complex viewpoints about what is important to see and to deal with in space', none of which is 'conceptually neutral'.[23] This might be usefully conceptualised in relation to what Haraway calls 'god-tricks', that is, perspectives liable to 'promising vision from everywhere and nowhere equally and fully'.[24] God-tricks are made possible by a misrecognition of a partial, active perspective as a universal, passive one. In other words, an observer fails to recognise that they view the world from a particular perspective and rather assume their point of view to be universal. Consequently, Haraway emphasises that all means of seeing are 'active perceptual systems, building on translations and specific *ways* of seeing, that is, ways of life'.[25] Since all visual representations originate from a point of view whose particularity ought to be taken into account, each perspective enables a highly specific view of the world and its order,[26] or – as is the case here – an architectural space which can be seen from multiple perspectives.

Representations of space, Lefebvre explains, are remarkable for their threefold "objectivity" as containers of objects, objects themselves and objectifications of plans. This notion of the "objectivity" of architecture will be central to the arguments made in this chapter as interviewees explain the process of creating a new terminal building from and through their representations of space. It resonates with Latour's observation of the gradual distinction between projects and objects in the creation of technological infrastructures, and his observations of projects which become objects. He writes that 'in the beginning, there is no

[20] Lefebvre, *The Production of Space*, 361. Emphasis in original.
[21] This is the perspective of Architect A1's drawing.
[22] Robbins, *Why Architects Draw*, 20.
[23] Robbins, *Why Architects Draw*, 27.
[24] Donna J. Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (London: Free Association, 1991), 191.
[25] Haraway, *Simians, Cyborgs, and Women*, 190.
[26] Haraway, *Simians, Cyborgs, and Women*, 190.

distinction between project and object. The two circulate from office to office in the form of paper, plans, departmental memos, speeches, scale models and occasional synopses'.[27] He warns us not to make hasty distinctions between them as they only separate gradually when some projects become realised into objects and open a 'gulf ... between the world of signs and the world of things'.[28] I am interested in observing the "becoming object" of airport buildings. That is, I am interested in the material, "objective" qualities of architects' representations of space and the ways they contribute to the production of airport space. This is a process similar to the transformation of 'a profile of a certain type of stone' drawn by the architect into 'something beautiful' carved by the stone mason, but it now happens in much transformed circumstances.

If we are to consider architects' work in the present day, it is important to realise that the representations of space of the architects interviewed here are no longer confined to 'sheets of paper', as Lefebvre has it above. The increasing use of computer technology has changed, if not the geometrical character of architects' representations, then certainly the way in which architects relate to such representations of space, their "objectivity" and the role they play in the production of space. Architect A6, who had given the account of architectural drawing in the Renaissance, states later in the interview that 'some time, forty years ago, computers started to be used in replacing the hand'. This amputation of the architect in favour of the computer also emerges as a shift in architectural cooperation.

Although drawing by hand continues to be central to architects' work, all architects I interviewed used a process called BIM, Building Information Modelling. Revit, the software mentioned by Architect A1 in the beginning for example, is part of BIM. Due to definitional problems of what exactly it would mean to 'use BIM' it is hard to pinpoint just how much BIM is used, but Race nevertheless argues that there is no doubt that 'BIM is being debated and implemented in some shape or form on a global basis'.[29] There is 'no single, agreed explanation

[27] Bruno Latour, *Aramis or the Love of Technology,* trans. Catherine Porter (Cambridge, Mass.: Harvard University Press, 1996), 24.
[28] Latour, *Aramis or the Love of Technology,* 24.
[29] Steve Race, *BIM Demystified: An Architect's guide to Building Information Modelling/Management,* 2nd ed. (London: RIBA Publishing, 2013), 21. A report by McGraw Hill Construction in 2010 suggests that in the UK, France and Germany, 36 % of the participating industry have adopted BIM, which 47% of architects being the primary adopters. (McGraw Hill Construction, "The Business Value of BIM in Europe: Getting Building Information Modeling to the Bottom Line in the United Kingdom, France and Germany: SmartMarket Report". (Bedford: McGraw Hill Construction, 2010), 4.) A 2012 report by McGraw Hill Construction notes that in North America, BIM adoption has increased from 28% in 2007 to 71% in 2012 in the entire industry, consisting of architects, contractors and engineers. The report adds that architects, who have been involved with BIM longer than the other groups, are the heaviest BIM users. (McGraw Hill Construction, "The Business Value of BIM in

or definition of what BIM is':[30] Numerous early definitions focused on BIM's technological capabilities, while recent definitions are wider in their scope and seem to regard BIM as a way of working and collaborating.[31] Eastman, Teicholz, Sacks and Liston, for example, stress that they see BIM as 'not a thing or a type of software but a human activity'.[32] This activity, they suggest, may have the potential to 'change the way buildings look, the way they function, and the ways in which they are built'.[33] Although it remains unclear what exactly BIM is, it is considered to represent a paradigm shift. It is exactly the difficulty in defining it which makes BIM such a useful talking point for illustrating architects' understanding of their work.[34]

Comparing AutoCAD, a computer assisted design software predating BIM, and Revit, a part of BIM, Architect A9 explains:

> Over the course of 15 to 20 years [prior to the introduction of BIM] all firms across the board have developed AutoCAD [computer assisted development] to a point where we can do flat plans, sections, elevations – 2D basically … So then there was this big transformation with a family of software that is considered the Building Information Management family. And that has Revit as one of its components, and that not only does the 2D, but as you put in information you are putting in three-dimensional information. So when you draw a line, you not only telling it: "It's 6 inches wide and 20 feet long", you are saying: "It's 20 feet tall also and it's made out of x,y,z material."

Revit is an architectural software which allows architects to transform the two dimensional models they had been using previously into three dimensional models which account for both height ("It's 20 feet tall also") and materiality ("and it's made out of x,y,z material"). Interestingly, the interviewee's descriptions seems to meet many of the criticisms raised by Lloyd Thomas in her discussion of architecture and material practice. While Lloyd Thomas suggests that drawing in particular 'describes only form, and relegates material to the empty spaces between the lines,'[35] this interviewee describes how a 'line' is perceived as a wall with particular dimensions and materiality. Lloyd Thomas also argues that the lack of consideration of materials leads to the false conception of 'the architect as a kind of mythic form giver',[36] but

North America: Multi-Year Trend Analysis and User Ratings (2007 – 2012): SmartMarket Report" (Bedford: McGraw Hill Construction, 2012), 4, 13).

[30] Race, *BIM Demystified*, 23.

[31] Race, *BIM Demystified*, 23.

[32] Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston, *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*, 2nd ed. (Hoboken: Wiley, 2011), 353.

[33] Eastman, Teicholz, Sacks and Liston, *BIM Handbook,* 353.

[34] Cf. John Rajchman, *Constructions*, with a foreword by Paul Virilio (Cambridge, Mass.: The MIT Press, 1998), 11 - 36, 91 - 108.

[35] Katie Lloyd Thomas, "Introduction: Architecture and Material Practice," *in Material Matters: Architecture and Material Practice*, ed. Katie Lloyd Thomas (London: Routledge, 2007), 2.

[36] Lloyd Thomas, "Introduction: Architecture and Material Practice," 3 – 4.

this interviewee seems aware of 'the very resistances that matter has to being formed'.[37] In fact, the conversation with Architect A9 helps to illustrate Lloyd Thomas' argument that 'materials must be extracted or manufactured, they must be worked and, once *in situ*, they must be maintained'.[38] As we will see below in more detail, materials should be considered to be active, in that they are involved in a mutual transaction with the architect rather than simply being shaped.[39]

Architect A9 also points out the continuity between drawing and information, when they explain the creation of a BIM model by saying that 'it starts with drawing it'. They continue and elaborate that 'as you draw it you are putting in the information. That is the input. The drawing is the input of information. And once it is there you can plot out, it is almost like a database then, you can plot out information from it'. This explanation is interesting, because it points towards a continuity between the foregoing discussions of drawing by hand and computer aided design, which seems to be going against the interpretation of their relation by Architect A6. Nevertheless, Architect A6 actually makes a similar observation regarding the inclusion of information about the drawn objects into Revit, albeit speaking in terms of 'folding':

> Now you can fold in your specifications, which are usually written documents that safeguard quality control. "Ok, I drew a window but what is it?" Well, the specifications tell you what the window is, its performance criteria, the maximum deflection, the quality control aspects of it and those can now plug into the BIM model. So, the written and the graphic are now one.

Information about the objects in the model can be "folded" into the model. As in the previous case, this allows for engagement with the material characteristics of an object, here a window, beyond its mere representation. In this regard, the model is said to combine 'the written' information about the window and the 'graphic' drawing of the window. Both interviewees, speaking in terms of drawing and folding, described how information is put into a computer model. The fundamental result of such a drawing and folding is a three dimensional model of the structure to be built. BIM enables a particularly 'information-intensive' – a description I borrow from Architect A9 – representation of airport space.

Architect A9 adds to this that BIM changes the perspective on architectural objects. While AutoCAD was able to provide architects with two-dimensional plans, sections and elevations,

[37] We will encounter Architect A9 again below, in a more direct discussion of materiality.
[38] Lloyd Thomas, "Introduction: Architecture and Material Practice," 3 – 4.
[39] Lloyd Thomas, "Introduction: Architecture and Material Practice," 3 – 4.

BIM also creates a three-dimensional model of the space. A similar process of moving from 2D to 3D is also apparent in the evolution of individual projects. Architect A8 explains:

> You know when you are doing things in BIM now, there is drawings that represent floor plans, the ceiling plans, the elevations and then there is the infamous BIM model which has everything in 3D. It is something different than a Revit model which shows you everything graphically, this one [BIM] shows you everything more qualitatively. So, we acknowledge that for a contractor, a BIM model is probably as valuable as the actual drawings. The drawings are basically the road map of everything in the BIM model. So you can look at the drawings to understand what is on the plan, what is on the floor, what is on the walls, what is on the ceiling.

In other words, 'doing things in BIM' entails the use of both two dimensional drawings such as floor and ceiling plans and elevations and the use of three-dimensional models. The two-dimensional models serve as 'road-maps' towards the three-dimensional model. In Architect A8's interpretation, the shift from a two-dimensional Revit model to the three-dimensional BIM model entails a move from graphic information to quantitative information. Whereas the two-dimensional drawings allow for an understanding of the three-dimensional model, that model itself is useful in terms of gaining information about the building and establishing its costs. I want to suggest that such a combination of two-dimensional and three-dimensional perspectives of space has introduced variation in how architects think about their work and how they relate to it. This is not necessarily a new phenomenon as such, but I want to suggest that BIM – by virtue of being computerised – has given architects new means of relating to such representations, and their "objective" characteristics.

Fat usefully makes a distinction between the architect as 'a manipulator of substance or material' and as 'a manipulator of space'.[40] For now, it seems that the former, invoked in the relation of architect and stone mason by Architect A6, has been replaced by the latter, embodied by Architect A1 who uses Revit to replicate a model of the entire space without having to draw it again. Fat suggest that this shift between the manipulation of substance and the manipulation of space occurred at the same time as a particular, abstracted understanding of space emerged.[41] Similarly, Forty suggests that a critique of such abstraction underlies Lefebvre's criticism of

[40] Fat, "Contaminating Contemplation," in *Occupying Architecture: Between the Architect and the User*, ed. Jonathan Hill (London: Routledge, 1998), 78 – 79.
[41] Fat, "Contaminating Contemplation," 78 – 79.

the 'space of architects' specifically.[42] Forty writes that 'its fundamental feature is the separation of mental space, from 'lived space'.[43]

Pallasmaa similarly adds that drawing and working with models puts architects in 'a haptic contact' with an object of space.[44] When drawn, 'the object is simultaneously held in our hand and inside the head and the imagined and projected physical image is modelled by our embodied imagination'.[45] As such, drawing locates the creator of the object simultaneously inside and outside their conceived object, calling for 'a bodily and mental identification, empathy and compassion'.[46] Like Architect A6 who had spoken of 'computers … replacing the hand', Pallasmaa states that the use of computers creates 'a distance between the maker and the object'.[47] The computer is said to contribute to a more abstract relation between the object and the architect. In the next section, I want to interrogate these assumptions about the distance between architect and space in more detail.

I.2. Drawing and folding, flicking and clicking

Given the dominance ascribed to BIM, it is important to reiterate that it nevertheless remains amorphous and undefined. Race states that 'BIM as a tangible entity does not exist'.[48] Rather, he suggests that 'in actual fact BIM is a state of mind'.[49] Discussing BIM, in other words, becomes a means of interrogating architects' understanding of their work. For this purpose, I am interested in exploring the continuities between drawing by hand and drawing by computer. Rather than accepting the assumption that there is no haptic contact between architect and model and that computer modelling leads to a more abstract notion of space, as Pallasmaa has it, I suggest that such a contact persists in a technologically mediated form. I want to suggest that architects' perspectives as mediated in BIM may, in fact, be taken to be a renegotiation of architects' 'embodied imagination' and that this accounts for a more complex account of

[42] Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), 274.
[43] Forty, *Words and Buildings*, 274.
[44] Juhani Pallasmaa, *The Eyes of the Skin: Architecture and the Senses*, 3rd ed. (Chichester: Wiley, 2012), 14.
[45] Pallasmaa, *The Eyes of the Skin*, 14.
[46] Pallasmaa, *The Eyes of the Skin*, 14. Note that this is not too dissimilar to Lefebvre's placing of the rhythmanalyst.
[47] Pallasmaa, *The Eyes of the Skin*, 14.
[48] Race, *BIM Demystified*, 31.
[49] Race, *BIM Demystified*, 32.

abstraction.[50] In order to examine this in more detail, it is important to consider how architects see their position in relation to the BIM model and how they interact with it.[51]

To begin, it is worth quoting Architect A9's discussion of the representational aspects of the BIM model:

> There is also other software that they can use within this family that then allows that to become shop drawings, to become literally what you see in the field and they look exactly the same as what gets built. They send their drawing to a fabricator, and they draw the exact same thing, make it in exactly the same way. And when you see it under construction, you can take a picture and look at the drawing, and it is exactly the same thing. Which should not seem weird but it is weird.

The interviewee registers surprise that the representations of a building in BIM resemble the building itself. This may point towards first, a surprise at the life-like representational ability of the BIM model but also then at the overlap of model and the building itself. There is surprise, in other words, about the representational capabilities of BIM. Throughout the interviews, architects discuss drawings and particularly computer models as means of understanding, seeing, and looking.[52] Talking about the BIM, Architect A8 explains that 'you can *look* at the drawings to *understand* what is on the plan, what is on the floor, what is on the walls, what is on the ceiling'. Architect A2 says that 'you can *see* spatially where things are fitting in next to each other' and Architect A9 explains that 'you can *look* at something and see a lot of *information* that is in that'. Explaining BIM's capacity for clash detection, Architect A6 points out that 'if you are building everything in three dimensions you can *see* when a duct is hitting a beam'. Interestingly, they add that '[BIM] can *automatically* detect clashes and conflicts', thus casting doubt on who is doing the detecting here. The same is true for others using the model later, Architect A9 adds, because 'the builder can use it in 3D and *see* what he is building'.

[50] Pallasmaa, *The Eyes of the Skin*, 14.

[51] Two other studies are worth considering here: When observing architects' interaction with CAD in 1993, Hall and Stevens point out a distinction between 'model space', the model as seen on the computer screen, and 'paper space', print outs of the computer models with which some architects prefer to work. While this is not a distinction I have encountered when asking interviewees about the more advance version of CAD and BIM, the distinction nevertheless helps in countering monolithic accounts of architect's use of computers. (Hall and Stevens, "Making space: a comparison of mathematical work in school and professional design practices," 137, 142). Similarly, Henderson's study of the drafting practices of engineers remarks upon the difficulties of transposing representational practices, 'historically paper-world practices', into CAD work (Kathryn Henderson, "The visual culture of engineers," in *The Cultures of Computing*, ed. Susan Leigh Star (Oxford: Blackwell/The Sociological Review, 1995).

[52] For a similar argument, cf. Kathryn Henderson, "The visual culture of engineers," in *The Cultures of Computing*, ed. Susan Leigh Star (Oxford: Blackwell/The Sociological Review, 1995).

These distinctively visual ways of understanding the model are facilitated by embodied interactions with its software. Architect A2 explained that 'you can *rotate* the view so that you can see spatially where things are fitting in next to each other'. Notably, it is the view that is rotated, not the position of the viewer, and this adds to the questions of perspective and god-tricks above. Architect A9 explains that 'all you have to do is *flick a switch* and it goes from a plan to a 3D image of what it is. And it is very information-intensive. So you can look at something and see a lot of information that is in that that you would not normally be able to put into something'. Architect A8 explains that 'technology allows you to look at things in 3D. The BIM model is set up for you to be able to *click on certain things* and *understand* their dimension, *understand* how much of that there is'.[53] I want to suggest that, while we had identified the hand as 'a discoverer of matter' above, gestures such as clicking and flicking may constitute different means of discovering information about objects for architects.

Reading together these visual and interactive aspects of BIM, I propose that such motions as 'rotating' and 'clicking' and 'flicking' may become new ways of thinking about buildings in BIM. Sudnow, in his discussion of learning to play piano, gives an account of the full-body aspects of motions such as typing while also giving a particular agency to the hand itself. He observes that 'this hand choses where to go as much as I do'.[54] Hayles observes similarly that 'research indicates that the small habitual actions associated with web interactions – clicking the mouse, moving a cursor, etc. – may be extraordinarily effective in retraining (or more accurately, repurposing) our neural circuitry'.[55] Edgeworth finally, in his discussion of computerized forms of visualization in archaeology, points towards the connection of the visual skill of correctly interpreting a computerized image and the embodied performance of interacting with it. He observes that '[one archaeologist's] visual skill is inextricably bound up with the deftness of the fingers in their extraordinary dance on the keyboard and the mouse'.[56] In other words, embodied interaction with computers may constitute a new way of understanding various activities.

[53] My emphasises through the paragraph.
[54] David Sudnow, *Ways of the Hand: A Rewritten Account*, foreword by Hubert L. Dreyfus (Cambridge, Mass.: The MIT Press, 2001), 1 – 2.
[55] N. Katherine Hayles, *How We Think: Digital Media and Contemporary Technogenesis* (Chicago: The University of Chicago Press, 2012), 2.
[56] Matt Edgeworth, "From Spade-Work to Screen-Work: New Forms of Archaeological Discovery in Digital Space," in *Visualization in the Age of Computerization*, ed. Annamaria Carusi, Aud Sissel Hoel, Timothy Webmoor and Steve Woolgar (New York: Routledge, 2015), 49.

Lefebvre writes, albeit in a different context, that 'bodies themselves generate spaces, which are produced by and for their gestures'.[57] I propose that this is apparent in architects' gestures, be that the 'drawing, erasing and redrawing' of Architect A6's account of architecture in the Renaissance or Architect A9's 'flicking', Architect A8's 'clicking' and Architect A2's 'rotating'. In other words, far from being merely visual, architects' interaction with their representations of space continues to be embodied. These ways of interacting, we had seen, are quasi-epistemological, illustrating clicking and flicking as means of seeing and looking and therefore as means of understanding space in a particular way. Another way of thinking about this would to follow McCormack's call for an 'affirmative critique of abstraction, which is interesting here not so much in defining abstraction as in investigating 'the kinds of work that abstraction is understood to do'.[58] Abstraction, here, is understood as a particular characteristic of representations of space, whose impact on the production of space ought to be considered.

Importantly, the production of space on the basis of representations of space should not be attributed solely to architects; it is rather reflective of the spatial practice of society at large.[59] Architects' representations of airport space are themselves the products of working practices in architectural firms and they contribute to the production of airport space. Schmid, Stanek and Moravánszky highlight that in Lefebvre's work space needs to be understood in relation to time because 'the notion of 'production of space' already implies time, as 'production' is a process that develops in time'.[60] Architects' doubled production of representations of space *and* of space itself gives us a first insight into the temporal characteristics of Lefebvre's thinking.

In the case of BIM, we find an acceleration of the production of airport space and a change in the manner in which various producers contribute to this process. This becomes apparent in Architect A8's personal account of the gradual shift of hand to computer. They explain that in the past 'you would have had somebody from each discipline measuring every little thing and writing it on paper, and adding it up, and double-adding and double-checking and all this stuff',

[57] Lefebvre, *The Production of Space*, 216.
[58] Derek McCormack, "Geography and abstraction: Towards an affirmative critique," *Progress in Human Geography* 36, no. 6 (2012): 728.
[59] Cf. Łukasz Stanek, "Architectural Project and the Agency of Representation: The Case of Nowa Huta, Poland," in *Urban Revolution Now: Henri Lefebvre in Urban Research and Architecture,* ed. Christian Schmid, Łukasz Stanek, and Ákos Moravánszky (Aldershot: Ashgate, 2014).
[60] Christian Schmid, Łukasz Stanek, and Ákos Moravánszky, "Introduction: Theory, not Method – Thinking with Lefebvre," in *Urban Revolution Now: Henri Lefebvre in Urban Research and Architecture*, ed. Christian Schmid, Łukasz Stanek, and Ákos Moravánszky (Aldershot: Ashgate, 2014), 13.

and as such highlight the importance of paying attention to detail. With the introduction of BIM, however, this step is no longer necessary. Architect A8 explains:

> It is a way of accelerating. When I started my career, we were drafting by hand. The fees were significantly higher in relation to the costs of the building because there was so such more labour in drawing. So, I remember as a student a 20 million USD addition to a building basically meant there were 20 people drawing – one per million. By the time I was working in building and there were 5 of us drawing. So … there are fewer people doing more things. So, BIM is another way of doing this; where you have so much more information to harvest, that fewer people can look at it and fewer people can then analyse it. So, the contractor needs less people to quantify.

The interviewee describes the evolution from drafting by hand to using BIM, which is reflected in an accelerating of speed of the processes, a decrease in the people involved relative to the cost of the building, and a decrease of the costs to the contractor of people creating the models.[61] These changes are important, as this quotation illustrates, because many interviewees will have experienced them in the span of their careers, and because they constitute important changes to the production of space.

Pointing towards the difficulties posed by BIM as a tool for coordination, Architect A8 explains that 'the most difficult thing with BIM is making sure that everyone who is putting into the model is very disciplined, speaks the same language … '. BIM, here, comes to serve as a disciplinary tool which ensures the compatibility of various inputs to create a homogenous, internally coherent model. Following Henderson, we might take the BIM models as 'conscription devices'. She writes that 'conscription devices … enlist group participation and are receptacles of knowledge created and adjusted through group interaction with a common goal'.[62] In other words, in order to manage the relations of the many people working on a particular project, each model implies a particular view of space to which they have to accept. While BIM models may not be straightforwardly reductive, Architect A8 nevertheless suggests that BIM's functioning requires discipline from those entering information in the model.

BIM is often taken as a means of communicating between the architects and others involved in the construction process and in this respect it resonates with the historical example of the architect and the stone mason cited above. Architect A8 explains:

> The engineers go kicking and dragging, not wanting to do it until last minute because they know we are constantly changing this room, that room, the stair location. They really do not want to engineer until we are done making major decisions like that. [That

[61] Cf. Pablo Miranda Carranza, "Out of Control: The Media of Architecture, Cybernetics and Design," in *Material Matters: Architecture and Material Practice*, ed. Katie Lloyd Thomas (London: Routledge, 2007), 152.
[62] Henderson, "The visual culture of engineers," 214.

> is] bad for the owner because the owner wants things quickly and if the engineers are waiting, it stretches the design schedule. If the engineers are waiting, it is hard to get a good estimate [of costs] because we are not showing stuff.
>
> The engineers will go: "Well, you have to pay us multiple times [for multiple drawings]". Architects are way too agreeable to just draw, draw, draw. Our passion is drawing. So, if we have to draw it once and they do not like the stairs there, we draw it again and they are like: "We don't like the stair there". [Unlike the engineers], we are not saying "We are stopping, you made us draw the stair twice". It is part of the iterative process, leading to the right answer.

This interviewee's impression of the present day drawing process is a remarkably different perspective from that of the historical account of Architect A6 cited in the beginning. Architects and engineers take up antagonistic positions in the 'iterative process' which centres on drawings. Architects have a 'passion' for drawing and are inclined to make numerous drawings. In contrast, engineers are characterised as unwilling to draw more than once and appear to demand renumeration if multiple drawings are necessary. Engineers are, in consequence, unwilling to draw while architects are still making changes and this, in turn, lengthens the design process as a whole and makes it more difficult to provide cost estimates to the owners. In contrast to the account of drawing, re-drawing, erasing and carving coming together in a cyclical 'creative process' of the creation of 'something beautiful' in Architect A6's historical account, this account describes the iterative process as a more antagonistic push and pull linearly running towards 'the right answer'.

Beyond the relation of architects and engineers, which will be internal to most large firms where the interviews took place, interviewees also describe the relation between architects and the contractors responsible for construction. This relation is divided into two variations: Design-Bid-Build entails the designing of a building by an architect and then the construction of the building by a contractor afterwards. This appears to be the traditional process of designing and constructing a building. In contrast, Design-Build is a more recent form of organising design and construction, in which architect and contractor work more closely together.[63]

Likely speaking about a traditional Design-Bid-Build arrangement, Architect A6, who had described the historical perspective on drawing, explains about the present situation:

> Now, the construction industry is purely a business and – I hate to say it – there is not a lot of love in it. Their goal is to make as much money as possible. So, the architect has to draw every single thing to protect the owner. If it is not drawn, the contractor

[63] Cf. Eastman, Teicholz, Sacks and Liston, *BIM Handbook*, 4 – 8.

> will cut ends. … The architect has to draw everything and if it is not drawn, the contractor will not build it or will charge extra money to build it. Or somebody discovers that it was built wrong and charges to rip it out, charges to redo it. So, documenting things becomes more and more important over time.

In this account, the relation between architects and the construction industry has become antagonistic. Architects are contending with a construction industry where 'there is not much love' and 'no pride of craft'. As in the case between architect and engineer, drawings, which had originally served as a basis for reiterative collaboration, now become a means of contestation between architect and contractor. While conflict between architects and engineers was about the pace of that process, here the realisation of an object in its entirety is dependent on it having been drawn. However, Architect A8's account of a Design-Build scenario gives a different perspective of the relation between architect and contractor:

> Design-building does not necessarily mean that we draw everything to the exact tiny degree because the contractor already knows what that is going to be. So, we might not elevate all the walls in a building because you have already met with them enough and it is captured in their prices already that they know what all the walls are going to be white and they are all going to be made out of drywalls. We do not draw it all. He does not have to go: "Well, what is it?" He already knows, and we might have a little note on it, saying: "All the walls in this room are white and drywall" as opposed to drawing each one of them because he has already bought into it. He already owns the documents, so it is a different way of doing things.

In Design-Build, the relations of architect and contractors are more collaborative than in the first interviewee's description of Design-Bid-Build. The contractor is involved in the project earlier, and they are therefore more familiar with the drawings.

Taken together, the observations make clear that whether a building is produced through Design-Bid-Build or Design-Build changes how architects' drawings are understood and how they become "object". While Architect A6 pointed out that 'the architect has to draw every single thing' when speaking about a Design-Bid-Build arrangement, the opposite is the case in Architect A8's account of Design-Build. Here, some objects do not need to be drawn and are rather replaced with a note stating what is to be build. While being drawn is a condition of being built in the first interviewee's account, Architect A8 illustrates that the drawings are here no longer essential. Architect A8 explains that a Design-Build relation leads to the integration and an acceleration of the production of a building. Design-Build offers 'a smoother process of them knowing all the time – we issue documents, they start to work on things, they start to price things and they continue to work on things'. As in the case of the architect and the stone mason, the process appears to be more integrated; Architect A8 explains that 'we might finish

some other drawings actually later, because they do not need them right now'. In other words, there is a closer coordination between architect and contractor in the case of Design-Build which sees the process of drawing more fragmented over time. In some sense, then, this second approach appears close to the original creative process described in the beginning.

In summary, this first half of the chapter began to trace the contribution of architects' representations of space to the production of airport space. It compared architects' drawing by hand with the computerised modelling in BIM. In doing so, it has illustrated that while computer modelling has been said to contribute to the increasingly abstract character of the relation of architects and space, it may also be understood as a continuation of the embodied nature of the production of representations of space. Highlighting gestures of 'flicking' and 'clicking' to 'see', 'look at', and 'understand' a space, I highlighted the ways in which architects understand and interact with computerised representations of space. I then continued to illustrate the role these representations may play in coordinating the relation between architects and contractors, noting that the function of drawings may vary depending on the contractual relation of architects and contractors.

Part II: 'It is not green, it is not a field'

In the second part of this chapter, I investigate the site on which airport buildings are constructed, and the buildings themselves. Broadly speaking, architects may be involved in two types of projects: greenfield projects, which build an airport on an entirely new site, and expansion projects on sites which are already used as airports.

To illustrate the challenges of greenfield developments, the former airport operator OR2 explains that Mexico City Airport is located in 'a mostly dried out lake in an earth quake zone' and that the ground has a consistency of 'something like jello'. In other words, the airport is located on extremely unstable ground, which it needs to mediate. This illustrates well that airports transform the physical spaces of their footprint and their immediate environment. Fuller and Harley describe airports as 'terraformers',[64] and write that they are established through 'the ceaseless remediation of the awkward materialities of place (like swamps and farming lands) into space that can be measured, represented and standardised'.[65] To investigate this further, I focus on the discussion of greenfield projects by the former airport operator OR2

[64] Gillian Fuller and Ross Harley, *Aviopolis: A Book about Airports* (London: Black Dog, 2004), 101.
[65] Fuller and Harley, *Aviopolis*, 41.

and Architect A11, who showed a particular interest in the topic. To begin with an example, Architect A11 explains about a potential airport project on Crete:

> Heraklion airport is just completely surrounded by the city and it is an awful approach and to get out of. So, the new project is going to build a greenfield in the middle of the island, which requires a new highway and also raises interesting questions about what that does to the environment of what is at the moment a really lost inaccessible part of the island. As you can imagine, Crete is very mountainous but there is one plateau in the middle, about 25 miles from Heraklion. It is completely surrounded by mountains but it is about the only place where you could possibly put a two-runway system on that island. Although – they start as a one-runway system, they will probably never get to two. But at the moment, it is very lost and it is charming. The Germans built an airfield there during the war. It was one of the few places where they could get an airfield.
>
> So, then you think: Is that wrong or right? I do not know. I guess it depends on what the Cretans themselves want to achieve in terms of infrastructure in that part of the world.

To paraphrase the problem described by the interviewee: Crete's current airport in Heraklion is surrounded by urban development and also poses challenges to the flight patterns of arriving and departing planes. A site for a new airport has to be found on the mountainous island. The only available site that offers enough space for an airport with one, and possibly two, runways is a plateau in the middle of the island. Architect A11's impression of this site is that of a unspoilt, 'very lost' and 'charming' place, albeit with traces of a former airfield established during the Second World War. Consequently, the possible construction of the airport on such a site poses 'interesting questions', Architect A11 explains, 'about what that does to the environment'. The architect himself is not able to answer that question, and rather defers judgement to 'the Cretans'. This dilemma is not unique, but rather illustrates questions often associated with greenfield projects. The former airport operator OR2 explains more generally that 'in the developed spaces in the world, there is not any space that has not been developed'. As a result, they continue, 'you are pushed to places where you would end up spending an awful lot of money to create the greenfield if you will'. This points towards an important challenge to the production of airport space – the unavailability of space – which leads architects to consider sites which would not have been regarded as suitable in the past and require large sums of money for the purposes of 'terraforming'.

I suggest that these observations may be conceptualised as the transformation of natural space into abstract space in Lefebvrian terms. They are illustrative of what Lefebvre identifies as 'the history of space as it proceeds from nature to abstraction'.[66] In Lefebvre's argument, nature

[66] Lefebvre, *The Production of Space*, 110.

and natural space stand at the very beginning of the production of space. 'Nature itself' serves as the 'raw material' for that production,[67] and the disappearance and transformation of nature and natural space is an implication of his thesis that social space is a social product. Consequently, Lefebvre's take on the contemporary status of nature and natural space is at best ambiguous. He observes:

> Granted, natural space was – and it remains – the common point of departure: the origin, and the original model, of the social process – perhaps even the basis of all 'originality'. Granted, too, that natural space has not vanished purely and simply from the scene: It is still the background of the picture; as décor, and more than décor, it persists more as it takes on symbolic weight (the most insignificant animal, trees, grass, and so on). As source, and as resource, nature obsesses us, as do childhood and spontaneity, via the filter of memory. Everyone wants to protect and save nature; nobody wants to stand in the way of any attempt to retrieve its authenticity. Yet at the same time everything conspires to harm it. The fact is that natural space will soon be lost from view. Anyone so inclined may look over their shoulder and see it sinking below the horizon behind us.[68]

Nature has been transformed into a background imagery invested with symbolism and it fascinates the observer. There is a drive to protect nature which is however futile in the face of its increasing transformation and destruction; it will 'soon be lost from view'. There is a danger of idealising nature in these arguments.[69] Butler warns that 'Lefebvre has a tendency … to reduce whole historical periods to a single motif', [70] and it might therefore be too simple to trace a singular development from nature to abstraction. Butler suggests that 'we need not read this story as a strict chronology of epochs and social formations', since Lefebvre also acknowledged 'the way in which different spatial formations may mutually coexist'.[71] Airport sites, I suggest, condense aspects of Lefebvre's history of space, by illustrating the transformation of natural space to abstract space, and the ongoing relevance of the natural features of the space. Lefebvre's arguments serve as a means of structuring my observations, but they do not encompass all observations in full.

Both the former airport operator OR2 and Architect A11 discuss Istanbul New Airport as an example of the challenges associated with the production of a seemingly "empty" site for an

[67] Lefebvre, *The Production of Space*, 123.
[68] Lefebvre, *The Production of Space*, 31.
[69] Neil Smith's work is seminal here in dispersing romanticised notions of nature and pointing towards the production of nature. (Neil Smith, *Uneven Development: Nature, Capital, and the Production of Space,* 3rd ed., with a new afterword by the author and a foreword by David Harvey. (Athens, Georgia: The University of Georgia Press, 2008), 49 – 92.) Cf. Stuart Elden, *Understanding Henri Lefebvre: Theory and the Possible* (London: Continnum, 2004), 134.
[70] Chris Butler, *Henri Lefebvre: Spatial Politics, Everyday Life and the Right to the City* (Abingdon: Routledge, 2012), 46.
[71] Butler, *Henri Lefebvre: Spatial Politics, Everyday Life and the Right to the City*, 46.

airport. The former airport operator OR2 explains that 'the site is so bizarre, you cannot believe it. It is lakes and hills and very high hills, it is rocky. It is just amazingly bad for an airport, but it was the only site that was available'. Similarly, Architect A11 explains that 'it goes up and down …That was a huge logistical challenge to flatten it out, even just to get the runways in place, notwithstanding the seismic issues, settlement and things like that'. This reveals the terraforming necessary for the establishment of a supposedly empty site, which may then accommodate an airport. The greenfield itself needs to be produced to become the site of the production of airport space. Architect A11 thus summarises: 'Istanbul, greenfield. Well, it is not actually. It is not green, it is not a field'.

In the case of Istanbul New Airport, at least, the motivation to build an airport on so unsuitable a site is ascribed to 'the Turkish mindset'. Echoing the observations of the former airport operator, Architect A11 explains that it is a 'crazy place to build an airport, really'. They continue, however, by stating that:

> The Turkish mindset is: "We are going to do it". They are the most boundlessly optimistic and driven people. So: "Yeah, that is where we are going to put it. Yes, it is going to be difficult but we are going to do it. Environment be damned. Risks be damned. Airspace be damned."

As in the case of the airport in Crete, the architect defers judgement to a people's understanding of their space. The fourth chapter will illustrate that such an association of a people and a space can be extremely complex and needs to be interrogated in detail. Lefebvre warns that 'the section of space assigned to the architect has nothing innocent about it'.[72] Indeed, Architect A6 suggests a correlation between the political system of a country and their ability or willingness to build greenfield developments. They observe that 'with the newer airports, [there are] people who can subvert the political process. … They do not have real political process. They have an autocrat on top who can say: "We are going to do this. Allocate the dollars, it does not matter what people say and how much they complain". And bingo!' In this understanding, the development of greenfield airports, then, is often pushed for by autocratic leaders without due political process.

Despite the metaphorical and actual flattening of the natural features of greenfield sites, airport operations continue to be impacted by some natural features. Lefebvre states that his thinking about the history of space is based on 'the spatio-temporal rhythms of nature as transformed

[72] Lefebvre, *The Production of Space*, 360 – 361.

by human practice'.[73] He is intent, in other words, on tracing the transformation of spatio-temporal rhythms by human actions in space. In order to illustrate the question of *rhythms* of nature on airport space in particular, I focus here on the impact of changing wind directions and their impact on airport sites. Describing their take on the production of greenfield airports, Architect A10 explains:

> If it is a greenfield, if it is a new airport, you start with the wind and the topography, because runways have to be orientated in line with the prevailing winds. So, you get meteorological data from the site. … Runways today, well always, were and are orientated in line with the prevailing winds because take-off and landing always happens into the wind, [but] sometimes during the course of the day the winds flip around often. You will notice in older airports, you often see crossing runways. That is because in the early days of civil aviation, the smaller aircraft, especially propeller aircraft, could not fight the wind, so you often have a crossing runway for a wind that part of the day or some season of the year runs perpendicular or at some other angle to the prevailing direction. With modern aircraft, jet aircraft, in most parts of the world you almost never see crossing runways being planned.

This account, as the previous ones, begins by considering the natural features of the site. In addition to topography, Architect A10 also accounts for prevailing winds. Unlike the hills, mountains and lake beds considered thus far, wind directions cannot be transformed and rather need to be accommodated by the design of the airport. Their impact can in part be ameliorated by technological improvements of aircraft. There is an interesting conjunction here of natural and technological factors at the beginning of the development of a new airport, with technology increasingly ameliorating, but not overcoming, the need to consider wind directions.

I suggest that such considerations of prevailing winds can be taken to be an example of the natural rhythms which continue to be central to the production of airport space. Since aircraft best take off and land against the wind, the alignment of runways has to follow the prevailing wind directions. In the past, when aircraft technology was less developed, changes of wind directions which follow daily or seasonal rhythms needed to be accommodated by the design of crossing runways. As such, the prevailing wind directions and its seasonal changes had to be inscribed in the space of the airport site. The improvement of aircraft technology diminished these "challenges", as jet aircraft can counter winds more easily. While runways still need to be orientated in line with prevailing winds, they no longer need to follow the rhythms of changes of wind directions as closely. As such, the operations of an airport are becoming more

[73] Lefebvre, *The Production of Space*, 117.

independent from natural factors – now abstracted into 'meteorological data', in the words of Architect A10 – but they still continue to reflect them.

Lefebvre observes that:

> In nature, time is apprehended within space – in the very heart of space: the hour of the day, the season, the elevation of the sun above the horizon, the position of the moon and the stars in the heavens, the cold and the heat, the age of each natural being, and so on … Time was thus inscribed in space, and natural space was merely the lyrical and tragic script of natural time … With the advent of modernity time has vanished from social space.[74]

Originally, time was perceived in space and the perception of space was secondary to the perception of time. However, the relationship of time and space has shifted. Lefebvre writes that while time had previously been inscribed in space, it is now expelled from space by economic and political forces in order to assert the supremacy of space over time.[75] Nevertheless, Lefebvre's judgement that time has disappeared from space is perhaps premature in the case of airport space. Architect A10 explains that while improvements in aircraft technology mean that crossing runways are no longer necessary 'in most parts of the world', they continue to impact existing spaces. For example, Architect 10 also explains that 'if you look at the aerial views of Heathrow you can see traces of where there was a crossing runway at an angle to the two parallel ones that are there today. In fact, it accounts for the orientation of terminal 4, which is at that funny angle to the rest of the airport'. In other words, the location of Heathrow's terminal buildings continues to be impacted by the layout of runways which were necessary in the past to accommodate cross-winds. The rhythms of the wind directions, in other words, continue to be inscribed in Heathrow's space despite the challenges posed by the winds having been ameliorated by technological means.

These observations illustrate an ongoing negotiation between natural features of sites and the abstract space needed to build airports. The narrative emerging here, is not exclusively one of the suppression of nature but also one of the ongoing impact of certain natural features such as the wind on airports. This illustrates a continual balancing of a domination of nature, as illustrated by greenfield developments, vis-à-vis an appropriation of nature in the case of runways which are mediated also by technological developments. These considerations of wind directions are important because they will recur, in a different guise, in the fourth chapter. We

[74] Lefebvre, *The Production of Space*, 95.
[75] Lefebvre, *The Production of Space*, 95.

will see that wind directions determine flight patterns, and therefore the noise exposure of the neighbourhoods underneath.

II.1. Geometries and flows

I now move on from a consideration of the site of an airport to discussing the building itself. Architect A1 suggests regarding airport buildings from the outset as 'compromised places' which are buffer zones between the spaces of the runway on one side and public transportation access on the other:

> The runway is always the first thing that is designed because it has to deal with prevailing winds. Access to the airport is the second thing that is always designed because you are coming in from some location near-by. And where the two of those meet, whatever the residual area that is left behind, that is where the airport terminal building lives. It always acts as a shock absorber; it always acts as the compromised place.

What we see here, then, is architects' negotiations of a space that is already inscribed in various ways. The airport building appears as a buffer zone between runways and landside access; it is a residue between access requirements on airside and landside. Airport buildings are, in this view, the excess of two intersecting modes of transportation. They function as a 'shock absorber' which compromises between the two mobility systems and changes according to their requirements.[76]

As aviation developed, airport spaces were structured in various ways before arriving at their current arrangement. Architect A5 explains:

> The first generation [of airports] was really a hangar with a little office. The second generation … brought the passengers and some of the amenities into the building, and then they added a second floor, so you started talking about vertical development, and you had a lot of support back of house in the second floor which were the control rooms, and weather stations, and all that, and all the public functions of the first. The third generation, the post-war buildings, ended up putting a lot of the back of house underground, they were totally invisible but you eliminated a lot of the overall of the airport function, because those went into other facilities. You are now not doing operations and control centres and control towers in these buildings, but they are all separate buildings.

There is, in other words, a constant stacking and restacking of the various functional levels of the airport, as new airport functions were added and then removed again from the terminal

[76] Cf. Anna Nikolaeva, "Designing Public Space for Mobility: Contestation, Negotiations and Experiment in Amsterdam Schiphol Airport," *Tijdschrift voor economiche en sociale geografie* 103, no. 5 (2012): 549.

building. Architect A8 explains that in contemporary airports, 'you want to stack a building to be most efficient'. As a result, most contemporary airports will have the arrivals level and the baggage handling system at the lowest level, with the departures level and administrative spaces stacked above. The geometry of contemporary airports is cut through by a line – which will also be discussed by the OR Expert OR3, in chapter 2 – which separates 'landside' and 'airside', that is, areas before and after security. Architect A10 explains that 'there is also a security demarcation that runs through the building that employees have to pass also if they move back of house'. This demarcation comes in the form of various security measures on door and access controls; its introduction will be particularly relevant to operational readiness, as we will see below. Moreover, Architect A8 adds that there have been attempts to change these structures, but they are generally unsuccessful: 'Every once in a while, someone tries to flip it and says "Let's put the arrivals on the top", which is odd'. Attempts at changing the existing order of processing arriving passengers and their baggage underneath the departing passengers have been largely unsuccessful, in their view. Architect A9 explains that 'if you want to be successful, you look at how somebody else did it successfully and try to mimic it'. As a result, most airports tend to be structured similarly.

Various parts of these geometries of airport buildings change in different manners. The area surrounding the terminal is unlikely to change much according to Architect A10 who explains:

> It is hard to imagine the ground surface reducing much in the way that – say – check-in has reduced by self-service processing, because the sheer number of service vehicles [required] to turn an aircraft around – catering, although [there are now] fewer meals on board, baggage, refuelling, all of those kinds of things. It is hard to imagine that reducing. All that equipment has to sit somewhere, and all of these people have to reside somewhere between the flights.

In other words, the volume of vehicles and people involved in the processing of aircraft makes it unlikely that areas outside the terminal building will change significantly. In contrast, spaces inside the terminal may change significantly. Architect A8 emphasises that some areas will expand while others will be allocated less space:

> You almost want to take the grand space of the check-in and the baggage check-in and everything and make the security and the retail the grand space. You want to go away from the whole getting out of the car and getting your bag on the belt, and waiting in line to change your ticket or get your boarding pass. It is getting so much more electronic, we are all going to end up tagging your own bags … That all reduces the size of the check-in hall and less time in the check-in hall. There is more time in security, and you want more time in retail after you get through security, to relax, to recharge, get your snacks, get your books, get whatever it is. Go to your gate. So, the grand space really wants to be secondary, the security and then post-security, the retail.

While the emphasis had previously laid on the check-in areas, the introduction of self-service check-in and the anticipation of self-service bag tagging is said to lead to a reduction of the space and time necessary for these processes. Instead, the space and time required for security control increase as do those of the post-security retail, which is used to destress passengers who have just passed through security.

Individual areas of terminal space evolve at different speeds and to different degrees. Architect A1 explains that 'if you were to compare the ticketing hall versus the arrivals hall, the arrivals hall will not see as much change as the ticketing hall because bag claim devices, I hate to say it, they are relatively common and they do not change that much'. Most architects seem to concur that security control is subject to the most frequent changes. Architect A9 estimates that security might be subject to changes of varying extent on a 'weekly' basis; 'sometimes it is a whole machine, sometimes it is just a protocol, but it is constantly changing'. This means that airport buildings change not only to different degrees but also on vastly different time scales and for different reasons. This poses significant challenges to airport architects. Older airports in particular often struggle to accommodate this multiple fragmentation. Architect A6, who had pointed out the need for efficient staking above, recounts that in reality 'all of these [older] hubs, you look at them, they are cobbled together of buildings that started being made thirty to forty years ago when airplanes were half their size, half their capacity'.

Considering the shifting shapes of airport sites and airport buildings, it becomes clear that it is difficult to pin down what exactly an airport is. Architect A8 suggests: 'You can call it a building, it is a processor. That is all an airport is, a processor'. This emphasis on the function of airports as processors of passengers recurs in other interviews. The former airport operator OR2 explains that 'it is a place to get people from land vehicles to air vehicles' and Architect A9 suggests that 'the function of an airport is really to get people from their landside location into a plane'. In a similar vein, Architect A10 explains that 'if you are designing any new project, you also start with a forecast, a traffic forecast, and then you back out of that through various planning metrics, and the fundamentals of that are the fleet mix, the aircraft that are being served, the landside access and the ground transport modes that you want to serve, and you really kind of figure out the terminal in between these two constraints'. This echoes considerations of the airport as a compromised place between the runways and the roads, and it adds passengers flows – configured as 'traffic forecast' – into the scheme. Such a forecast indicates the volumes of passenger flows and their rhythms and considers how departing and arriving passengers will access the airport. These notably functionalist definitions of airports

by interviewees,[77] resonate with understandings of airports as 'flow machines'[78] and 'movement machines' in the literature.[79]

By virtue of their architectural characteristics, airports pose significant challenges to passengers' mobility. Architect A8 explains that 'airports are skyscrapers on their sides', and that they 'do not really like to grow in height' because this could increase their operational costs. As relatively flat, horizontally organised structures,[80] they are prone to require passengers to walk lengthy distances. Architect A10 emphasises that 'even though at the end of the day most architects are accomplished enough to make it seem as if the terminal is a coherent architectural piece, it is driven by so many other factors that are really fundamental to what an airport is'. Airport buildings need to funnel passenger flows, and the accomplishment of the architect lies in their ability to create coherence under these conditions. Architects' skill, following the quotation, lies in the ability to paper over the cracks of an inherently compromised place and give the impression of the airport as a coherent building.

It is worth going back briefly to considering BIM, and to explore how such passenger flows are imagined by architects. Architect A9 describes two programmes through which the computer models discussed above can be used to simulate flows:

> They [the software] are another layer. So, they take a BIM plan and feed in a flight schedule of information, which is basically passengers, and it turns the flight schedule into numbers of people coming at a time. You have to give each person a rule. You know: "I am going to go to the bathroom and then I am going to get a ticket. And then I am going to do this and do this". And you do all that within a time frame of when the person arrives and when the plane takes off. And then it runs the model and it takes x percentage of people and they are all doing these different things and then by analysis that will produce a drawing that shows orange, yellow, red, green and that tells you where congestion is occurring and if you can fix that as an operational fix – putting more staff at counters instead of leaving them empty – or whether you need more counters or you need more physical space to deal with the congestion.

The interviewee explains how passengers are imagined in BIM in a variety of configurations. The architect begins with a 'flight schedule' which is translated into 'numbers of people coming at a time'. From this number, individual 'persons' are given rules for their movement in a given time frame. However, it is then again a 'percentage of people' fulfilling the tasks in

[77] For a discussion of Lefebvre's understanding of functionalism, cf. Forty, *Words and Buildings,* 193.
[78] Fuller and Harley, *Aviopolis*, 5.
[79] Fuller and Harley, *Aviopolis*, 41. Cf. Cresswell, *On the Move*, 237. He refers to 'machines for mobility'. Interesting, we will see in the second chapter that the OR experts interviewed for the second chapter would disagree with this assessment.
[80] Interestingly an architect cited below will point towards the parallels to elevators.

question. The result is a colour-coded drawing, which indicates if 'congestion' occurs. Adding to this, Architect A8 points out that there is a particular temporality to the passenger flows depending on the location and function of any airport:

> It is very cyclical. … And when you have an airport where everyone is going in and changing flights, a huge amount of people [are] all arriving at the same time. Even if you do not hub … they tend to appear all at the same time because even all the competitors want their planes to be leaving first thing in the morning to go back to their main hub and then come back in the middle of the day to pick up more people and they want to go back to their main hubs in the afternoon, and so you even get peaks and valleys in airports that are not hubs because everyone wants to leave at certain times, everyone wants to arrive at certain times.

Passenger flows are cyclical, both in hub airports where many passengers transfer, and in origin-and-destination airports, which will have few transfer passengers. Large groups of passengers tend to arrive at the same time, and these changes in passenger volume need to be accommodated spatially. The discussion of the cyclical character of passenger flows introduces an additional rhythm, which needs to be accommodated by a building. In fact, Architect A1 warns that such volumes need to be considered carefully since 'the easiest thing in the world is to either overbuild or underbuild a terminal or an airport, which of course you can ill afford'.

Following the accommodation of such volumes in the space, Architect A6 explains how these flows are imagined in the structure of the building:

> Departure is on top, arrival is underneath it, baggage usually at the same level as arrivals but behind it. Landside versus airside. Landside, you tend to segregate your incoming and outgoing passengers both because of security reasons – you are clean or you are dirty at an airport: you are clean when you have been processed [through] immigration and security. You are dirty when you can walk in from the street, nobody knows who you are, what you are carrying. You have not been cleared, you are still firmly in the country where you were, and then you go through immigration [and] you are no longer technically in that country which is why you can do duty free because now you are outside of the country's duties. So, those are segregated for security reasons, but they are also segregated for flow even on the land side. Landside you are considered dirty and you can mix. Airside, you are clean and you cannot mix. … Baggage is always underneath the clean people, it is on the apron level because the planes are on the apron, the bag tags are on the apron, everything that brings [the bags] is on the apron and it is directly plugged into the baggage management system where then your bags are whisked away underneath you, which is usually on the same level, not always. And then that is the level you go down to pick up your bag and then you go through customs. It is just flow.

Strikingly, Architect A6 describes the same stacked division of the building that had already been laid out above by Architect A8. Architect A6, however, also considers the movement of

passenger flows and baggage flows in their description.[81] They explain that typically airport buildings consist of two sections for departing passengers and arriving passengers respectively, with the former being located above the latter. These sections are then subdivided into airside, accessible only to passengers who have undergone immigration and security control, and landside, which is open to the public. Baggage handling facilities are, ideally, located on the same level as arriving passengers. The arrangement is driven by considerations of passenger flows, and by the distinction between 'clean' passengers who have undergone security control and 'dirty' passengers, who have yet to undergo such controls. This, again, marks the boundary between landside and airside. Modifications to the scheme should follow these considerations. Architect A6 explains that sometimes it is not possible to follow the exact layout; rather 'you might segregate departure in two levels, with ticketing on top of immigration or security'. Nevertheless, they conclude that 'it is always from A to B to C'.

Imrie observes that much architectural theory begins by 'relating design parameters to the proportions of the human body'.[82] Such considerations of proportions, however, have their origin in a particular image of the body as 'able-bodied, taut, upright, male, an image projected as self-evidently invariable, normal, vigorous and healthy'.[83] This is in itself problematic because it excludes various other bodies. Moreover, the idealised bodies are then abstracted even further and rendered 'object'.[84] Following Lefebvre, Imrie writes that in contemporary architecture, 'the body was reduced to physical matter, subsumed by the rationality of geometry and mathematics, or instruments for the technical control of practical operations'.[85] Cresswell points out that such an image of the passenger specifically is described as PAX in the case of airports, that is, 'generic passengers with no identifying marks'.[86] He suggests that PAX are used to model the movement of passengers in airport terminals, and sees PAX as 'a symptom of a synoptic perspective on space that enacts a transformation of mobile bodies into a legible record that can be analysed by the panoptic gaze of the architect, planner and engineer'.[87] PAX here are taken to be abstractions of moving passengers into records which are legible to the

[81] The coordination of these flows will be discussed in more detail in the second chapter.
[82] Imrie, "The Corporealization of Codes, Rules and the Conduct of Architects," *Perspecta* 35, Building Codes (2004). n.p.
[83] Imrie, "The Corporealization of Codes, Rules and the Conduct of Architects," n.p.
[84] Imrie, "The Corporealization of Codes, Rules and the Conduct of Architects," n.p.
[85] Imrie, "The Corporealization of Codes, Rules and the Conduct of Architects," n.p.
[86] Cresswell, *On the Move*, 238 – 239.
[87] Cresswell, *On the Move*, 238 – 239.

producers of airport space, including architects. The tension between an individual person and a PAX will becoming apparent in the second chapter.

Cresswell writes that the removal of 'the clumsy fleshiness of real bodies' allows for the abstraction and standardization of movement.[88] Elsewhere, he chooses to represent his understanding of movement as 'a vector between two points A and B'.[89] He distinguishes between movement and mobility,[90] and suggests that 'movement can be thought of as abstracted mobility (mobility abstracted from contexts of power)'.[91] Movement in his view is a "fact", which needs to be contextualised to become mobility.[92] Mobility, in turn, 'is as a social product' and it 'does not exist in an abstract world of absolute time and space, but in a meaningful world of social space and social time'.[93]

My argument would rather be precisely that mobility and movement exist and coincide in abstract space. In this, I follow Adey observation that passengers' movements in the terminal are treated as indivisible flows, rather than as the movement of individual passengers. Consequently, they are modelled as 'vectors that eventually become real in the 'real' material environment of the terminal'.[94] Counter Cresswell, Adey argues that such vectors as representations of mobility are a sign of the rational abstraction and quantification of passengers' movement. They are not only abstractions of a 'fuller reality' of the passenger as Cresswell has it.[95] Following Adey, I argue that no distinction can be drawn between an 'abstract world of absolute time and space' and 'a meaningful world of social space and social time', and the configuration of movement in each.[96] Both of these are the same, because abstraction itself is a social phenomenon. Consequently, the abstract character of architects' representations of passengers' movement is not a removal of mobility from its political context. Rather, it is indicative of the social contexts in which such representations are produced and the politics implied therein.

[88] Cresswell, *On the Move*, 239.
[89] Cresswell, *On the Move*, 2. Cf. Peter Adey, "Airports: Terminal/Vector," in *Geographies of Mobilities: Practices, Spaces, Subjects*, ed. Tim Cresswell and Peter Merriman (Farnham: Ashgate, 2011), 146.
[90] This is not a distinction shared by all scholars. Urry seems to be using the terms movement and mobility, and others, interchangeably.
[91] Cresswell, *On the Move*, 2. Emphasis removed.
[92] Cresswell, *On the Move*, 21.
[93] Cresswell, *On the Move*, 5.
[94] Adey, "Airports: Terminal/Vector," 140.
[95] Adey, "Airports: Terminal/Vector," 146.
[96] Cresswell, *On the Move*, 5.

The question of how the airport should move people within its building continues to be an unsolved architectural challenge. Asked about moving walkways, Architect A8 comments that 'they drive me crazy. I really wish we could figure out what the solution is'. They explain that there are two ways of enabling passengers to move faster through the terminal; moving walkways and people mover trains. Asked to elaborate on the previous sentiment that walkways drive them crazy, Architect A8 explained:

> There are going to be more mega airports with longer walking distances and the jump between moving walks is a people mover, a train, which only gives you limited choices. It is really expensive to make a people mover train stop. Elevators are costed by their stops. It is not the elevator shaft, that is not expensive. The elevator is not expensive. But all the mechanism for the doors and everything and the call buttons and the software to make the doors open, that is what drives the costs up for an elevator. It is the same turned on its side. It is the stops that cost.

A people mover train, in other words, transposes the vertical movement of elevators in skyscrapers into a horizontal dimension, but it does not offer a solution of the airport architects' dilemma. While walkways are too slow and do not cover enough distance, people mover trains confront the opposite problems of needing to cover large distances in order to be effective. The interviewee explains:

> You cannot have one [a people move train] that stops every three gates because they you are like "I am never going to get anywhere" and you are going to be frustrated. You can never [get] up to enough speed. So, I keep thinking: "There's got to be some brilliant solution of something in between a moving walk[way] and a train." That is what is kind of missing at these airports.

This illustrates the complex, and changing relations of space, time and movement which need to be accommodated in the terminals. Cresswell observes that 'movement is made up of time and space. It is both a spatilization of time and a temporalization of space'.[97] This leads to a complex, mutually constitutive relationship in which 'time and space are both the context of movement …. and a product of movement'.[98] The architect's dilemma, I want to suggest, illustrates the complex relation between space and time on the one hand, and movement on the other hand, in the airport.

[97] Cresswell, *On the Move*, 4.
[98] Cresswell, *On the Move*, 4.

II.2. Surfaces and what's underneath

The foregoing discussion of moving walkways and people movers trains is also interesting because it points towards the relations between the airport terminal space and passengers' movement. Adey observes that movement shapes space, and is shaped by space.[99] Similarly, Chen points out the convergence of multiple rhythms and materialities in walking – 'With one leg swung into the air, our bodily tension accumulates as the upright body is on the verge of falling. To maintain the momentum, the foot needs to touch the ground and let the other leg stride forward'.[100] Moreover, she points out, walking means interacting with a material environment that is being traversed. She explains that 'the movement of the body is in constant negotiation to the material affects of the surroundings, prompting a range of bodily gestures that mutate and reinvent the rhythmic formations of walking'.[101] A person walking will be shaped by the space they traverse, and will be shaping it in turn.

Consequently, airport buildings need to be produced so as to withstand the wear and tear of movements, as well as that of their operations more generally. This is accommodated primarily by architects' choices of building materials. Architect A1 emphasises in that context that 'most of the wear surfaces – floors, ceilings – should be certainly designed to be able to give you twenty to twenty-five years before they start to really require a review'. Architect A8 explains similarly that 'you really want to have durable materials'. They then continue to explain that 'that is why you see a lot of Terrazzo floors. Polished concrete is the new flavour of the month, looks kind of cool and beautiful and it is a little bit rougher … Definitely things on the walls. You can only imagine that the lower levels with all the cart traffic and luggage traffic, it needs to have a resiliency to that as well'. They also emphasise the need for durability, while also alluding to a differentiation between the lower (arrivals) levels and the higher departures level, depending on whether there is luggage and cart traffic or not. In both cases, however, there is a need to balance the visual characteristics of a surface ('cool', 'beautiful') with the resilience of the materials.

Along similar lines, Architect A9 points out that surface materials need to be easily replaceable. They explain that 'carpet tile is very easy to modify'. They continue to point out that '[on] big long sheets of carpet, if there is a big long spill or some cut in it or something, to replace that, it is so obvious. It is not a good choice'. Instead of a single carpeted surface then, they explain,

[99] Peter Adey, *Mobility* (London: Routledge, 2010), 19 - 20.
[100] Yi Chen, "'Walking With': A Rhythmanalysis of London's East End." *Culture Unbound* 5 (2013), 533.
[101] Yi Chen, "'Walking With'," 533.

'it is better to choose things that are modular and that can be replaced without affecting other things'. They then move on to make the same point about the ceiling of a terminal, explaining 'you would add a ceiling and again it is modular. So, if one of the tiles breaks or there is a leak and it gets destroyed in that way, you just replace it'. In these observations, Architect A9 points towards the modularity of surfaces, which facilitates maintenance. By using floors and ceilings which consist of parts, replacement of damaged parts is made easier. Modular surfaces allow for the replacement of damaged modules without such a replacement being visible and without affecting the rest of the surface. Interestingly, Architect A9 also points out that individual parts can be kept in storage for future use. They explain that 'you can store a whole bunch of them. You can keep a lot of stuff in storage somewhere and then be able to come in [and use it]'. In other words, parts of the surface of a terminal building may be 'in storage' for future use, thus adding another dimension to the temporal characteristics of the surfaces.

Following Hill, I propose that what is at play in all these discussions are questions of who gets to impact the design of a building and who does not.[102] The spills, cuts, breakages and leakages recounted by Architect A9 are indicative of changes to the appearance of the terminal which are impacted by something other than the architects' plans. They are caused, rather, by the movement of passengers (spills and cuts) and even by the matter of the building itself (breakages and leakages).[103] Hill speaks specifically of 'reactive users' and 'creative users', with the former modifying a space according to parameters set by the architect and the latter, contrary to set parameters, modifying the meaning or use of existing space and creating new ones.[104] The examples used by the architects so far follow a somewhat different track by being accidental rather than intentional, as Hill's seems to imply. My point, pushing Hill's argument, is that all usage impacts space, whether intentional or not. The challenge here is not the visibility of the damage itself but also the fact that a replacement of the damage would be 'obvious', in Architect A9's words. That is, in addition to surfaces needing to not show damage, we also find that they may not show signs of damage having been repaired. The surfaces discussed here should not show any signs of use, be that wear and tear or maintenance. The importance of this thinking about surfaces will become apparent below.

[102] Jonathan Hill, "The Use of Architects," *Urban Studies* 38, no. 2 (2001): 354.
[103] Hill, "The Use of Architects," 354.
[104] Hill, "The Use of Architects," 355.

Such considerations of damage, repair and maintenance are particularly important in the design of airports, because those investing in the building will be operating it subsequently. Architect A6 observes:

> In airports … the person who puts up the money or the entity, government, or quasi-governmental or private enterprise of an airport authority, they are keeping that building and so they really care about its operational costs. So, they make decisions not just on capital costs but long-term costs: "The floor may be cheaper today but am I going to have to replace it in five years but then it's more expensive? How long is this system going to last? How long is the warranty on these windows? Is this going to be maintenance free?" Maintenance, maintenance, maintenance. That is what you always what you hear from owners that are operating buildings.

Due to the fact that the entities which invest in airport developments are likely to be that developments' long-term owners, they consider not only the short term costs of construction of an airport but also the long-term costs of operating and maintaining it subsequently. The architect estimates that ninety per cent of the costs over thirty years will occur in operational costs in comparison to 10 per cent in professional and construction costs. These considerations extend to various parts of the airport building, such as flooring and windows, with particular attention being paid to maintenance. The questions recounted by the interviewee may be taken as indicative of what Lefebvre identifies as the 'theory of obsolesce'.[105] Lefebvre explains:

> There is a "demography" of objects, recording the life expectancy of this or that product, and the market is organised in terms of the life expectancy of objects. Each "life expectancy" is calculated, for every object: two or three years for a car, a dozen for a bathroom.[106]

There is, however, a key difference between Lefebvre's demography of objects and Architect A6's thinking. While theories of planned obsolescence work with the assumption that producers anticipate the obsolescence of their products, the architect explained that the various entities who may invest in an airport project and then be its owners, have an interest in their operational costs. The emphasis, consequently, is on operationality rather than obsolescence, and 'the demography of objects' in airport space is established with a different motive in mind by producers and investors. When such considerations are applied explicitly to spatial aspects, such as the flooring and windows, we find that airport space even though it may be encountered as a coherent space by the passenger disintegrates into its composite parts. The demography of objects operates on temporal levels which differ not only in their length but also in the certainty

[105] Lefebvre refers to Vance Packard explicitly (Henri Lefebvre, *The Survival of Capitalism: Reproduction of the Relations of Production*, trans. Frank Bryant (London: Alison and Busby, 1976), 110).
[106] Lefebvre, *The Survival of Capitalism*, 109 – 110.

with which they may or may not occur. Some of these are definite lifespans, such as the need to replace flooring or a system. Other are hypothetical, in case something breaks, such as in the case of the window. The lifespans are, in turn, translated into various types of financial transactions – such as replacement costs or warranties – which can be both certain or merely possible, working in favour of the owner or against him. This is therefore not merely a difference in the lifespan of an object as Lefebvre considered in his demography, but also in the certainty of this lifespan.

It is important here to note that all interviewees cited so far are concerned with *surface* spaces. Crucially, these spaces are not merely to be looked at, as would be the case in Lefebvre's assumption which draws parallels between the façade and perspective,[107] but they are walked on in the case of the floors and touched or collided with in the case of the wall materials. The crux here is to maintain them in a good condition in which signs of wear and tear are not apparent. Lefebvre points towards the role of the façade in relation to 'the realm of what is visible' and what is 'condemn[ed] to obscenity'.[108] He explains:

> A façade admits certain acts to the realm of what is visible, whether they occur on the façade itself (on balconies, window ledges, etc.) or are to be seen from the façade (processions in the street, for example). Many others acts, by contrast, it condemns to obscenity: these occur *behind* the façade.[109]

The façade, in other words, makes a distinction between what is intended to be seen and what is to remain invisible. Such distinctions, Lefebvre suggests, lend themselves to a thinking of a 'psychoanalysis of space', and of the 'obscenity' behind the façade.[110] Speaking in similar terms, Cairns and Jacobs intend to provide 'a "perverse" view of architecture', by building 'a sensitivity to how buildings waste, deteriorate, and die'.[111] Shifting the conversations from wear and tear to maintenance, and consequently from a surface space to the area beneath it, Architect A10 observes:

> The biggest issue is not so much wear and tear, but it is maintenance and access to the building … for flexibility. Coming up with solutions that allow the air conditioning or the lighting to be serviced without shutting down areas in the concourse. So, you do not

[107] Lefebvre, *The Production of Space*, 273.
[108] Lefebvre, *The Production of Space*, 99. He speaks about this in terms of 'acts'; I am extending this logic to space itself.
[109] Lefebvre, *The Production of Space*, 99.
[110] Lefebvre, *The Production of Space*, 99.
[111] Stephen Cairns and Jane M. Jacobs, *Buildings Must Die: A Perverse view of Architecture* (Cambridge, Mass.: The MIT Press, 2014), 1. For related arguments, see Keller Easterling, *Subtraction* (Berlin: Sternberg Press, 2014), and Arjun Appadurai, foreword in *Infrastructural Lives: Urban Infrastructure in context*, ed. Stephen Graham and Colin McFarlane (London: Routledge, 2015), xii.

> want an engineering exercise to lock up a piece of thoroughfare. You have to keep people moving, you have to keep operations live.

This consideration of access constitutes a move from the surface of the façade to what lies behind it, while at the same time emphasising that the normal operations of the terminal need to continue. At this point, it also becomes apparent that in order to accommodate change, architects need to ensure access to spaces beyond the surface of the airport building. This may be both for the purposes of repair as well as future planning. Architect A1 explains that the space beneath the floor surface may be used to accommodate possible changes in the future:

> For instance, under a floor: If I know in this case I am going to end up changing the configuration of these [check-in] kiosks, then it is up to me to be able to anticipate what would be in this floor to allow things to poke up and to be changed without continually making the floor look like cheese. So, that is where the flexibility is built in most good terminals.

Architect A8 also explains that the space beneath the floor may be used to enable flexibility for future change:

> There is all these troughs in the floor, cavities that all the wires and data run so that we can put plugs wherever we need because the security check point is going to slide back and forth. So, the data is this way and they can go back and forth. So, wherever we need outlets we put outlets.

All three interviewees describe spaces behind the surfaces of the terminal, and point towards ways of breaking the surface and making connections – 'access', 'allowing things to poke up', and 'put plugs wherever we need' and 'wherever we need outlets we put outlets' – between these spaces. The spaces behind the surface are intersected by troughs and cavities to allow to accommodate air conditioning and lighting, data and wires. At the same time, however, this in-built potential for change remains hidden behind the surface of the building. Change is, on the one hand, built into the building but it is also, on the other hand, denied on its surface.

It is worth remembering here that this need to accommodate change is not exclusive to the terminal space. The former airport operator OR2 explains that the accommodation of maintenance in general poses significant challenges to airports because they are always operational. They state that 'it would be nice to not have activity in certain times, so you could really do those kinds of things, but it is not always possible'. Instead, they explain that 'a lot of the time, if not all the time, you would schedule these big complicated work-arounds. You go and do some massive maintenance project, you shut areas down. It is much more complicated'. If large maintenance needs to be accommodated, in other words, parts of the airport building

are temporarily closed off, and operations need to be scheduled around them. To illustrate such a work around, OR2 explains about runway maintenance in particular:

> Except for breakdown maintenance, you do all the airfield work at night, because there are fewer airplane movements. So, it may not be closed but there is a lot less of it. [The airport where the interviewee worked] has three runways, two that are primary runways. So, you do the maintenance on one of them. You close one at night to do an operation, both landing and take offs, on one runway. So, you can narrow the operation, so you can do the maintenance work that needs to be done.

At large airports, runway maintenance is undertaken mostly at night, when fewer flights are departing or arriving.[112] Such runway maintenance operations require significant, and continuous planning. The interviewee from the Port Authority PA1 explains, for example:

> Runways have to be repaved. If you use asphalt, it has to be repaved every ten years. So to plan for a runway closure and to do the work necessary to bring in 15.000 people to repave a runway …, because they are three miles long, and it is not just the asphalt, it is drainage, it is electrical, lighting, all kinds of things.

As in the previous observations, the challenge of such maintenance becomes apparent when we consider the material of the runways and their functions. Far from mere repaving, runway maintenance also involves various additional functions necessary for their operations. Given the size of such a project, runway maintenance needs to be planned for in advance. The interviewee explains:

> You almost have to plan for that two years in advance because the airlines have to maybe pull back their schedule to accommodate that activity. If you have four runways every two years, it is almost constant. And that is just the runways. What about the taxi ways? And then the terminal work? So, there is constantly activity going on at the airport.

This further illustrates the continuous importance of maintenance and – in this case – the cyclical patterns it which it occurs. Airport buildings and airport sites more generally consist of a large variety of objects – floors, ceiling, carpet tiles, and ceiling tiles, tiles in storage, troughs, wires, data, windows, lighting, air conditioning, runways, runway drainage – which operate according to different temporal scales. Asked what they suggest I should consider in my research, Architect A10 responds as follows:

> You have no doubt already noticed the incrementalism of all these places in the way they grow, like Heathrow, like JFK. You know, Newark was set down as a nice, coherent plan when it was first established or re-established but since then there have

[112] These observations about runway maintenance are interesting because they point towards the night-time activities of airports. The question of airport's "night life" will resurface in the fourth chapter.

> been all sorts of additions and the same thing with Gatwick. Obviously, Stansted had a nice, big plan in the beginning but now it is evolving in a direction that had been completely unforeseen at the time it was established … Most airports struggle along and go from project to project without rethinking the overall plan. But then again, a lot of original masterplans proved inflexible and they themselves became obsolete. It think that is one of the interesting things about airport development.

The quote sets out the importance of considering change and growth at airports and, particularly, how such growth can and cannot be anticipated in airport projects. The examples illustrate what the interviewee described as the 'incrementalism' of growth, in that airports, which may have been built with a clear plan in mind, then grow in unexpected dimensions, leading them to become complicated, fragmented buildings. The architect suggests further that much of such growth is not conceptualised clearly, and this will be the concern of the next section.

II. 3. Growth

Rahim writes that 'architecture traditionally has been associated with notions of permanence and stability'.[113] He suggest that time is to be negated in traditional architecture and its effects are to be resisted.[114] However, such thinking stands in tension with the specific architectural requirements of airports. This is perhaps most starkly apparent in one conversation in particular. Pointing towards the present day plans for a project in their office, Architect A8 explains:

> [The firm] did a building fifty years earlier that was literally right here … We replaced a million square [foot] building fifty years later with a new million square foot building, which I think in the history of men, I do not think many firms can say they do that. It is hilarious. How many architects tear down their own million square foot building and build a new one back on?

The firm had to demolish their own obsolete building in order to replace it with a new, functional one. Cairns and Jacobs hypothesise that 'for architects invested in the professional myth of creativity and permanence, there may be no greater wound to their professional identity than witnessing a building of their own design being demolished'.[115] This interviewee, however, finds the situation 'hilarious'. Demolition, while initially appearing to be the opposite of assumptions about permanence and stability when taken on its own, may slot into a more complex interpretation when the rebuilding of the site is considered. Cairns and Jacobs point

[113] Ali Rahim, *Catalytic Formations: Architecture and Digital Design* (London: Taylor and Francis, 2006), 22.
[114] Rahim, *Catalytic Formations,* 22.
[115] Cairns and Jacobs, *Buildings Must Die,* 210.

out that demolition allows architecture to follow its 'creative drive', that is the turning of '"unimproved" land to productive use'.[116] This thinking is not too dissimilar to observations about architects' transformation of natural sites into greenfields discussed previously, in that both rely on destruction in order to build. Cairns and Jacobs take this as a revelation of 'architecture's perverse secret': 'its professional stability, and its ability to reproduce itself, depend on demolition, as both a material fact and a psychic desire'.[117]

Pushing this point further, I want to shift my attention to the incompleteness of airport buildings: The fact that airport terminals have a maximum lifespan of 50 years is a common wisdom in the interviews, and as such it is ill-suited as the 'secret' in question. The crucial point, rather, lies in the realisation that the spaces created by architecture are in fact never complete, always fragmented and subject to constant change. Airport buildings are subject to continuous change within their 50 year lifespan. 'It constantly morphs. It constantly morphs', Architect A8 explains.[118] In consequence, airport architects are said to have 'a responsibility to manage change by designing buildings that accommodate it from the outset'.[119] Indeed, throughout the interviews, it becomes apparent that architects are not only extremely aware of time, but also work to ensure that their buildings can accommodate change over time. This is what Edwards has identified as a 'hierarchy of change, with – generally – the slow parts (site or structure) dominating those, such as finishes, that are renewed more frequently'.[120] This hierarchy will be maintained, Edwards explains, until short term change accumulates so much as to make a more fundamental change of slow, or hard, spaces necessary. Until that point, however, Edwards writes that such a hierarchy 'allows the airport to survive as a recognizable entity yet still adapt to management changes'.[121]

Architects have various strategies in order to anticipate and accommodate change. Architect A9 distinguishes between 'soft spaces' which can be moved easily in the future and 'hard spaces' which contain elements which could not easily be moved. This distinction will translate into the permanence or impermanence of these spaces within an airport:

> Depending on [the geometry of the terminal], there are strategies within those geometries that we are aware of that help us decide where [we] are going to place some of these fixed elements to know that we maintain our flexibility to change over time.

[116] Cairns and Jacobs, *Buildings Must Die,* 197.
[117] Cairns and Jacobs, *Buildings Must Die,* 197.
[118] Cf. Brian Edwards, *The Modern Airport Terminal: New approaches to airport architecture*, 2nd ed. (London: Spon Press, 2005), 91.
[119] Edwards, *The Modern Airport Terminal,* 91.
[120] Edwards, *The Modern Airport Terminal,* 94.
[121] Edwards, *The Modern Airport Terminal,* 85 – 87.

> And then, you put soft spaces like offices in areas that we would expect that some expansions would have to occur in the future.[122]

Soft spaces are more likely to be subject to change over time than hard spaces. I want to suggest here that the softness or hardness of spaces, which remained somewhat amorphous throughout the interview despite the interviewee's indication that they are strategies suggested by geometries of the building, may be indicative of a particular relation between time and space.

Moreover, the architects interviewed here were concerned with the durability and flexibility of the material they use. Architect A10 observes that construction materials will permit varying degrees of flexibility, pointing out that 'it is hard to do major alterations on most terminals, but if you use a fairly wide, fairly large dimension structural grid and use steelframe construction, you have a better chance of altering the building later on than if you have a dense structural grid with in situ concrete, that is harder to alter'. Concrete is said to be less changeable than steel, especially when the flexibility of floor plans is considered as well. Making a similar point, Architect A9, who had introduced the distinction between hard and soft spaces, elaborates on the relation of building materials and change, which is complicated by considerations of material costs:

> A concrete structure is much less forgiving and much less easily modified. ... In terms of just flexibility, wood or steel is much more flexible than concrete is. Now, if you are talking about a location where steel is really expensive but concrete is really easy and cheap and the labour, even though that is labour intensive, is cheap, doing something in steel is probably not going to happen. But if you are just talking pure flexibility, yes, those materials are much more forgiving.

The interviewee explains that concrete is less changeable than steel and wood, but they also add that the use of materials will depend on the material costs and labour costs at a site. Mirroring such distinctions between soft and hard spaces, materials which are more changeable and less changeable, Lefebvre broadly distinguishes between material and *matériel*. He explains that 'materials are indispensable and durable: stone, brick, cement and concrete, for example … *Matériel*, by contrast, is quickly used up; it must be replaced often; it is comprised of tools and directions for their use; and its adaptive capabilities is limited: when needs arise, new *matériel* must be invented to meet them'.[123] Lefebvre does not go much further in analysing this distinction, but the realisation that materials may operate on different time scales serves as a useful starting point. As already alluded to above, the choice of material is dependent on the industry of the locations where an airport is to be built. Architect A8 explains:

[123] Lefebvre, *The Production of Space*, 105.

> In Mumbai, India is a concrete construction industry, so all the lower floors are concrete and the major columns are composite concrete steel. And then the roof structure is all steel. So, you work with the industry, but in that case we also had to design the steel structure with relatively short members because the Indian steel mills, that is what they were used to putting out. We did not want to have to import large steel members and all of the customs duty that would have been piled on top of that. So, you work with whatever the industry can support.

This goes to illustrate that as much as architects operate globally and as much as they follow general rules, their materials do not and thus make architects dependent on local conditions. This is curious to note in particular because other parts of the airport building will be imported, and are not dependent on local conditions. Architect A1 explains that 'equipment that is necessary to run an airport – travellators, elevators, passenger boarding bridges, mechanical systems – those are not fabricated locally'. In other words, some of those parts of an airport which might then physically move passengers and bags through the airport will themselves have been transported around the world. Even in terms of their origin, then, the materials and *matériel* of airports constitute a complex assemblage of local and international materials.

Beyond the durability and flexibility of their materials, airports are also designed in distinct sections which can be built, changed and added to to accommodate change. Architect A1 explains that 'for many firms, the answer is simply to build … one very big box and then allow lots of smaller boxes into it, so that you can change the little boxes out of the much bigger box'. The interviewee is not in favour of this approach, [124] but it is a useful way of conceptualising what other interviewees described as construction in phases and modules. Architect A9 explains:

> [Phasing] allows you then to only build what you need. You are building the size of box that you need so that the cost of that is offset by the passenger volume. And then when you start seeing that this is getting tight and it is a real thing and not just an operational problem, then you know it is time to expand and then when you expand you know that the extra revenue is going to cover that.

Phasing describes the expansion of an airport building in accordance with the passenger numbers. The increase of passenger numbers necessitates the expansion of the buidling, and promises an increase in revenue which makes such an expansion affordable. This way of expanding is accommodated by the modular structure of the buildings. Architect A9 explains that 'we design buildings now in such a way that they are modular, so they can be easily expandable… So that it is easy to expand in the future on an as-needed basis, when the

[124] Cf. Lefebvre, *The Production of Space*, 94.

passenger demand grows'. In other words, the building is designed in sections which allow for a smooth expansion as passenger numbers grow. Adding to this, Architect A6 makes clear that modular building is also an expression of the relations of existing spaces and their potential for change. Modules, in other words, allow for multiple possible uses of a single set space. In the case of the airport, this equation includes of course a great variety of possible uses making up a modular building. Architect A6 explains:

> You do things on modules: You can move a loading bridge, you can multiply the number of seats, you can move the contact gates, you can rip out a piece of the bag system or increase it by extending the baggage handling system because everything is on top of each other.

Each space can have multiple functions, and spaces are exchangeable. By implication, this also means that they are perceived as forms which may serve as containers for multiple functions. The individual units of space have become exchangeable with each other; they can be 'moved', 'multiplied' and 'ripped out', emphasising the physicality of the architects' thinking, making apparent their ongoing engagement with the material shaping of architectural space.[125] At the airport, this means that airport space becomes exchangeable with itself: a particular form of space can be used to fulfil various functions. Lefebvre points out that there is a 'need for compatibility' which leads to the production of 'virtually identical 'cells''. He suggests that 'the theory of 'modules' and its practical application have made possible to reproduce such cells, taken as 'models', *ad infinitum*. Space is thus produced and reproduced *as* reproducible'.[126] Such a replicability of space had, of course, already been apparent in Architect A1's suggestion that entire sections of the Middle Eastern airport could be produced on the basis of the reversed Revit models of the current project, or when Architect A9 mentioning the possibility of storing modular parts of the floors and ceilings for future use.

These considerations come with assumptions about the prospective growth in the future of any airport which is measured in passenger numbers. Architect A9 describes the expansion process of a terminal as a whole as follows:

> Say, something is designed to be able to handle a passenger flow of 3 million a year. What we typically do, and most planners do this, we then say that it could probably handle up to 5 [million annual passengers]: "When you get to three million, better start planning your next expansion". And then, depending on who is running the airport at the time, they then put the next bench mark. They will say: "We have enough money for this size of expansion". We tell them: "That will serve you until you get to eight million". Well, that could take two years or it could take 15 years. It completely depends

[125] Cf. Cairns and Jacobs, *Buildings Must Die*, 197.
[126] Lefebvre, *The Production of Space*, 337.

> on the market. We really do it based on passenger demand rather than a time frame, because anything would happen.

What we see here is the future planning and gradual expansion of an airport building as passenger numbers grow. This, in turn, is dependent on market developments, Architect A9 explains. Importantly, the need to expand is taken for granted by almost all architects interviewed here. In fact, Architect A6 explains:

> Everyone has growth projections because you have to because there is only a certain number of passengers you can process at every pinch point in an airport – the number of planes that can land on the runways, the types of planes because of the length of the runways, the taxiing capacity, the number of contact gates, the number of hardstands, which is what we call the gates that do not have contact to the terminal but you have to go onto a bus and the buses have to get you where you are going, the amount of security processing, immigration processing, baggage processing, customs processing, ticketing processing – all these things, each are a pinch point. Nobody has projections going down, they are all going up.

The abstract notion of 'growth' is here directly translated into passenger numbers and then concrete characteristics of planes and the infrastructure of runways and the apron – such as the runways' ability to accommodate a number of planes, the type of those planes, the spaces needed to accompany taxiing, gates and hardstands – and various steps of the passenger processing through security, immigration, baggage, customs and ticketing. The airport itself becomes a series of 'pinch points' in which the numbers of passengers constitute a challenge which needs to be met. It is interesting here that growth needs to be considered not because there will be growth, but because the airport needs to be able to accommodate growth in case it does occur. 'Everyone', meaning all airports, assumes that there will be growth, that is, that their passenger numbers will increase. The centrality of assumptions of growth and the physical expansion of the buildings is also illustrated well by Architect A9, who remarks that any airport project needs to consider expansion from the start: 'if it cannot expand and you expect that you are going to need to in fifty years, then it is not a good plan and you have to come up with a different alternative that can'. The ability to accommodate growth is a marker of the quality of a plan, and plans which fail to accommodate growth would be replaced with more capable plans. For Lefebvre, growth 'implies an ideology'.[127] He writes that 'growth seems to develop a logic; the strategy of growth is confused with the ideology of growth. Growth is claimed to be necessary and determined; it is forecast mathematically'.[128] Thus conceived mathematically,

[127] Lefebvre, *The Survival of Capitalism*, 102.
[128] Lefebvre, *The Survival of Capitalism*, 109.

Lefebvre suggests, growth is quantifiable and can be enumerated in countable measures.[129] Thus conceptualised, growth is desirable by default, because the presence of more passengers is perceived as always a good development. Moreover, indefinite growth seems possible because there is no conceivable reason why passenger numbers should stop growing or even shrink when perceived exclusively mathematically.

Some architects are aware of the dubious character of growth in their considerations. Architect A11 makes clear that such growth can occur in a variety of different ways, and is difficult to predict:

> The joke we have with our clients is: "Your forecast is brilliant. Really. Thank you very much for giving it to us, but you do realise it is completely wrong?" And depending on who they are they understand it more or less. Effectively, you have to come up with a product that gives you sufficient flexibility for the airport infrastructure and the buildings to be adapted to different modes of operation depending on where that growth takes them: If you grow by twenty million with a legacy carrier with a high transfer traffic, it is a completely type of building than low cost O-&-D [Origin and Destination traffic with few transfer passengers], in comparison to the same number, 20 million, but with very small amounts of transfer passengers. It is amazing, the kind of difference to the kind of building and the infrastructure that you need.

The joke here is that all growth predictions are likely to be false. The architect explains that growing passenger numbers can take a variety of forms which have impact for airport space. The requirements of the airport as a building will be dependent, specifically, on the nature of the traffic. An increase in transfer passengers will require a different arrangement of airport space than an increase in arriving and departing passengers, and this links back to considerations of passenger flows through the geometry of the building discussed above. In consequence, future planning has to aim to be able to provide solutions for various such scenarios. The ideological character of growth also becomes apparent in Architect A8's description of growth. Illustrating at once the unpredictability of passenger growth and the ideological dimension of its predictions, the interviewee explains:

> I like to call it sorcery. There is the true numbers of what is happening right then and there. Then there are the numbers that come out of the blue- for instance, an airline can go out of business and another airline can swoop in and pick up all their market. Low cost carriers have gotten so much traffic and they are at these other airports where there was never traffic and they cannot handle all these people coming and going. And then you have the occurrence of very large aircraft, that then also create large plugs of people when they come in. And then there is the hoped for numbers. That very often the cities that know that air traffic is vital to the survival of their city as a piece of commerce. … And so then you have these airports who will build large capacities, saying "We have

[129] Lefebvre, *The Survival of Capitalism*, 109.

> the capacity to handle your company, and don't worry, when you move in then the flights will come because of all these empty gates. We could just fill them right up with planes.

In other words, passenger numbers can indicate different aspects – they may indicate current passenger numbers or at other times that may be the result of unexpected increases of passenger numbers due to a change in the airline business and aircraft technology. Lastly, Architect A8 discussed 'hoped for' numbers which are particularly interesting in the case of 'ideologies of growth'. Here, airports are built in anticipation of large passenger numbers in the hope that that anticipation itself will allow such numbers to materialise. The circular logic of this thinking is readily apparent – building for growth is taken to be as a means of provoking growth. According to Lefebvre, contemporary growth 'knows and recognises itself as end and means simultaneously'. However, 'ends and means are confused, and the means becomes the goal, the end'.[130] As a consequence, growth has become an end in itself.

The possibility that airports might not grow, and that the provision of air services to some airports might be reduced, is one that architects are only becoming accustomed to now. Pointing towards changes in the US aviation system which saw smaller hub airports decrease in size, Architect A10 observes that 'we are still in a period of trying to come to grips with: "Is this a permanent condition of less air service to places like Kansas City, St. Louis, Cincinnati, various places? Or, you know?" It is important to note here that the thinking about modules and phases is unidirectional. Having been explained phasing and modular building, I asked Architect A9 whether it might be possible to reverse the design and whether there are plans for airports to scale back. They respond: 'There typically is not, but that is a very good question'. Asked the same questions, Architect A10 laughs and stresses that 'that is a really good question because the world is full of obsolete terminals and some were designed not that long ago'. Architects only seem to be starting to consider the future of such airports, but the interviewee points out that this is difficult – 'they are starting to think about ways they can repurpose those buildings but it is not that easy to do. They are not really conducive to other uses'. Architect A10 explains that 'they usually end up moth balling the terminal buildings and moving everyone into one terminal and closing another, or closing part of a terminal, which is really expensive to do, but it is also expensive to demolish'. The full terminal is no longer needed and demolition being too expensive, the terminal is 'mothballed'.[131] 'Mothballing', Architect A10

[130] Lefebvre, *The Survival of Capitalism,* 109.
[131] It is interesting to read this in the context of Easterling's speculation regarding a 'subtraction formula'. (Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space* (London: Verso, 2014), 50.

explains, means 'depending on the climate you have to keep a certain amount of heat going because you do not want all the pipes to freeze and stuff. So, the system is running at a low level, it is not a no-cost situation'. Interestingly, then, even non-operational terminal will be impacted by the weather conditions. More generally, the mothballed terminals are interesting because they draw into doubt the assumptions of growth build into airport space.

Conclusion

To summarise, this chapter engaged with the production of airport space by considering the work of airport architects. Architecture theory has been engaging with Lefebvre's work since the 1990s,[132] but Beech warns of a 'domestication' of Lefebvre's work in which architecture is merely taken as 'a 'representational' medium, mobilized by higher, abstract authorities.[133] This domestication, he suggests, is not 'politically innocent' but rather a reflection of a broader social democratic, neoliberal context.[134] Architecture theory continues to regard architecture as a signification of something outside of itself.[135] Architecture, in other words, is always taken to be merely a representation of something else. Countering this, Beech himself argues that 'the task, then, is to demonstrate that architecture, as a particular process of production, is also necessarily a particular process of production of subjects/bodies and a state mode of production'.[136] Here, architecture is embedded in a broader process of the production of space, while also actively contributing to it. Architectures is, in this view, not merely a representation but it is also and perhaps more importantly a spatial practice, and I hope that the observations made in this chapter speak to this thinking.

Lefebvre himself is not kind to architects, and it is worth citing his description at length:

> The architect, producer of space (but never alone) operates over a specific space. Firstly, he has before him, before his eyes, his drawing board, his blank paper. … This drawing paper, who does not consider it for a simple and faithful mirror? Whereas all mirrors are deceptive and besides, this blank sheets more and something else than a mirror. The architect uses it for his plan in every sense of the word: a flat surface upon which a more or less nimble and skilful pencil leaves traces which the author takes for the reproduction of things, of the tangible world, while in fact this surface forces a coding and recoding of the 'real'. The architect cannot, as he easily tends to believe,

[132] Nick Beech, "Ground Exploration: Producing Everyday Life at the South Bank, 1948 – 1951," in *Urban Revolution Now: Henri Lefebvre in Urban Research and Architecture*, ed. Christian Schmid, Łukasz Stanek, and Ákos Moravánszky (Aldershot: Ashgate, 2014), 194.
[133] Nick Beech, "Ground Exploration," 192 – 193.
[134] Nick Beech, "Ground Exploration," 193.
[135] Nick Beech, "Ground Exploration," 194.
[136] Nick Beech, "Ground Exploration," 194.

> *localize* his thought and his perceptions on the drawing board, *visualize* things (needs, functions, objects) by *projecting* them. He confuses *projection* and *project* in a confused ideality which he believes to be 'real', even rigorously conceived, and so escapes him because the procedures of coding and decoding are routine and traditional. The sheet at hand, before the eyes of the draughtsman, is as blank as it is flat. He believes it to be neutral. He believes that this neutral space which passively receives the marks of his pencil corresponds to the neutral space outside which receives things, point by point, place by place. As for the plan, it does not remain innocently on paper. On the ground, the bulldozer realizes 'plans'.[137]

The quote begins with a consideration of architects' production of drawings as representations of space. Lefebvre considers a drawing paper which is deceptively blank. He points towards the reductive qualities of drawing, when he observes that, far from being simply 'a skill and a technique', drawing is 'a mode of representation, a stipulated and codified know-how. [138] This means that drawings function as filters, 'selective towards contents, eliminating this part or that part of the 'real''.[139] Drawing, in other words, is reductive. He suggests that the architect understands their work as one of reproduction, merely representing a pre-existing space beyond it. However, Lefebvre points out that the architect's seemingly neutral surface of a blank sheet is already implicated in assumptions about existing space and what the architect perceives as a mere reproduction of existing objects and space is also a production of objects and space in the first place.

The architects interviewed here are, as we have seen, part of a globally moving kinetic elite. Moreover, they stand in a global competition to contribute to the production of airport space. Airport architecture is a global industry. Architect A11, based in the UK, explains:

> Most regional centres have expertise which has grown around their local growth. So, the United States, the Spanish speaking world,[140] France, not so much Germany curiously, Russia for sure, China, not so much India. Eastern Europe: Serbia, Poland. So, they each have their area that they look after and there is no doubt that within each of one these regions you can find plenty of competent people to do an airport.

These firms, the interviewee makes clear, stand in constant competition with each other, and since most interviewees will be employed different by firms they will stand in competition with each other. They move around the world, contribute to the production of an airport space and move on. The chapter gave two accounts of the beginnings of airports as recounted in expert interviews with a number of architectural practices: First, large sums of money are invested in

[137] Henri Lefebvre, *Writings on Cities*, selected, translated and introduced by Eleonore Kofman and Elizabeth Lebas. (Oxford, Blackwell, 1996), 190.
[138] Lefebvre, *Writings on Cities*, 191.
[139] Lefebvre, *Writings on Cities*, 191.
[140] It seems that the interviewee refers to Latin America here.

order to prepare sites for the construction of an airport by terraforming their natural characteristics. Theoretically, this discussion allowed us to begin to investigate Lefebvre's notion of natural space, and his suggestion that natural space is disappearing. While the production of airport space may initially be taken to be a domination of nature, we have also seen instances in which nature may not be dominated but rather needs to be accommodated, such as in the case of runway orientations in line with prevailing winds. Second, architects make use of the abstract space of BIM models in order to conceive of airport space. However, BIM models are not as abstract and exclusively visual as one might assume, if we take into account the flicking and clicking that have become architects' means of interacting with the model.

BIM, by virtue of its information intensity, also allows architects to model passenger flows, and we saw the construction of abstract PAX, programmed to follow rules, in the next chapter. We saw architects' consideration of material in order to cope with such flows, and – going beyond the surface – the last section introduced airport architects' emphasis on the need to accommodate the future development of airport buildings through modules and phases. Importantly, modules and phases are a way of thinking about – designing – that building, as is the selection of materials we had discussed previously. As such, considerations of materials and the modularity and phasing of a building extends through the past, present and future of the buildings. Modules can be concrete and material at present, but they can also be still-virtual, still just anticipated, for the future.

The chapter has begun to draw out some notable themes of Lefebvre's work – natural space, abstract space, the relation of space and time, rhythms – which will recur throughout the thesis. Taken together, these observations are illustrative of a broad understanding of production, in line with Lefebvre's thinking on the production of space.[141] This production is both mental and material. Airport buildings are produced both as ideas and as objects in space, and the discussion of architects' clicking and flicking of the BIM model and the insertion of information about the materiality of the model illustrated that even such a distinction might be a fraud. This is not to say that the relation between mental and material production is not subject to tensions and negotiation, as illustrated in the distinction of Design-Build and Design-Bid-Build.

[141] Cf. Elden, *Understanding Henri Lefebvre*, 44.

Throughout the interviews, there is a sense of disbelief, expressed by the interviewees themselves, which cannot be dispelled easily. The idea that a drawing should look like a project under construction 'should not seem weird but it is weird', according to Architect A9. Greenfield developments are neither 'green' nor on 'fields', according to Architect A11, and the site in Turkey is labelled as both 'crazy' and 'bizarre', according to the former Airport Operator, OR2. The challenges of people movers, themselves largely the result of the need to move passengers across vast distances in expanding terminal buildings, 'drives … crazy', Architect A8. It is 'hilarious' that a firm should be replacing their own, large scale project, according to the same interviewee. These descriptions suggest that architects, as 'producer[s] of space', may be more aware of the challenges associated with their work than Lefebvre gives them credit for; in fact, a similar sense of ambiguity towards airport space will also recur in discussions by other interviewees in the subsequent chapters. Although architects are closely involved with the production of airport space, their descriptions of that process nevertheless retain some uncanny aspects relating to the sites and representations of airport spaces, and their multiple, in-built temporalities. Despite their close involvement, the production of airport space remains partially incomprehensible even to the producers themselves, and this may have to do with the complex and multiple spatial and temporal dimensions of the space in question. Lefebvre has offered us a model for thinking about the relation of time and space. He writes:

> Time is distinguishable but not separable from space … Phenomena which an analytical intelligence associates solely with 'temporality', such as growth, maturation and aging, cannot in fact be dissociated from 'spatiality' (itself an abstraction). Space and time thus appear and manifest themselves as different yet unseverable.[142]

In this chapter, I hope to have illustrated how architects work to incorporate a whole variety of temporalities in their considerations of the airport. Architects described their accommodation of natural rhythms such as wind directions in the runway layout. They described the cyclical character of passenger flows, and their impact of the sizing of the terminal. They explained the need to select durable surface materials, intended to withstand wear and tear, and the need to repair and maintain surfaces without making repairs obvious. This became more apparent, even, in architects' discussions of growth, and their accommodation of the potential for growth in the modular design of a building. We find, in other words, that airport buildings combine a large variety of intersecting time scales, while at the same time aiming to present a homogenous surface for those travelling through them.

[142] Lefebvre, *The Production of Space*, 175.